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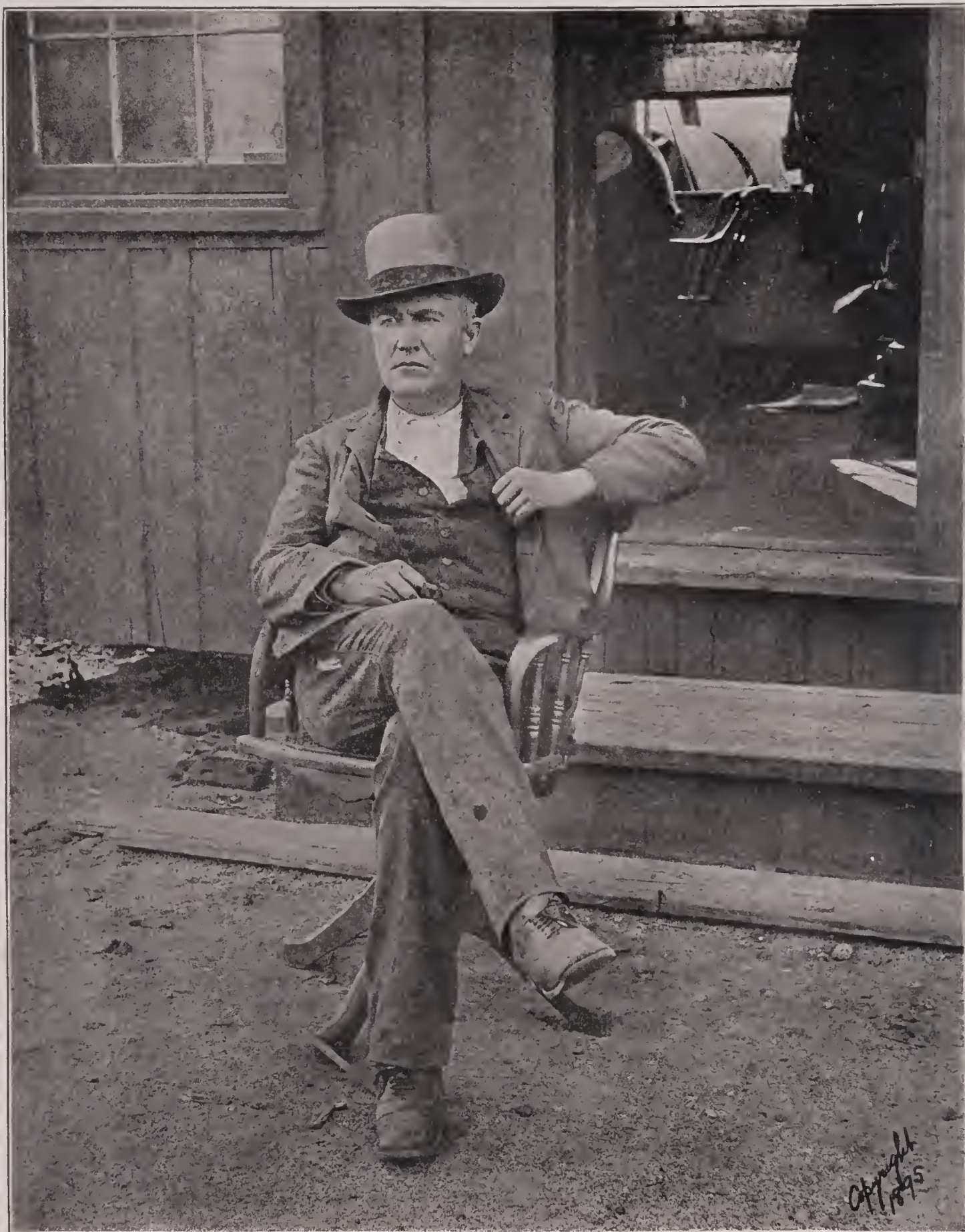
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THOMAS A. EDISON, THE WORLD'S MOST FAMOUS INVENTOR.

Photographed in front of his office at his Ogden, N. J., iron mines. This picture of Edison in his working clothes is very life-like, and the only one of its kind that has been taken.

OUR WONDERFUL PROGRESS

THE WORLD'S TRIUMPHANT KNOWLEDGE AND WORKS

A VAST TREASURY AND COMPENDIUM
OF THE ACHIEVEMENTS OF MAN
AND THE WORKS OF NATURE

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A graphic account of the gigantic consolidations and combinations of world-wide influence, and the commercial and mechanical methods of the world's great industries

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BOOK II

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Depicting the development and the applications of the great natural forces and principles utilized by mankind



BOOK IV

Amazing Wonders of Nature

The greatest and most significant among the works of nature, contrasting vividly with the works of man

BOOK V

Things We All Should Know

An array of selected information, popular, technical and statistical, on a multitude of subjects of everyday value and importance

*Five
Comprehensive
Books
In One Volume*

Embellished and Illumined by Nearly Four Hundred Photographic Illustrations

EDITED BY

TRUMBULL WHITE

AUTHOR, TRAVELER AND GEOGRAPHER, ASSISTED BY A CORPS OF SELECTED SPECIALISTS

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To
THE AMBITIOUS, THE STUDIOUS
AND THE INDUSTRIOUS,
BE THEY IN HIGH OR HUMBLE STATION,
IN WHATEVER WALK OF LIFE,
This Work is Dedicated.

TO THEM THE WORLD'S PROGRESS
TOWARD ENLIGHTENMENT
AND HAPPINESS
IS DUE.



PREFACE

The work here presented is calculated to serve the needs of at least two distinct classes of readers, neither purpose primary, neither purpose secondary, but both kept constantly in mind as standards by which all matter considered for entrance into the pages should be measured. In one aspect it is intended to be a book for the busy reader, the practical reader, the reader in haste, who seeks definite information and facts about the world as it is to-day. In the other aspect it is planned to be a book for the entertainment and instruction of the studious reader, who wishes to understand the processes and progress of modern conditions the world over. It is a book of live subjects, on the achievements of man and the works of nature, so presented as to make it equally adaptable for pleasant reading, ready reference, accurate instruction or careful study.

The educational qualities of the work have been kept prominently in mind from the first planning of it. Never before was there so great a demand for the knowledge which is power. What the world wants is the man who knows. This is the age of universal education. There is no excuse for ignorance to-day. The demand for men of broad mental equipment is never wholly supplied. The positions demanding such men are much more numerous than qualified candidates to fill them. The men whose energy and ambition prompt them to strive patiently for mental improvement in spare hours, are few in number, compared with the vast majority content to stagnate, year after year, in poorly paid subordinate positions. Those who pay court to knowledge by systematic home study, eventually secure the choice places. The field is open, the opportunities were never more numerous. It is believed that the volume in hand is a storehouse of such essential information as will assist the ambitious reader to take advantage of the manifold opportunities, by acquiring the methods of modern progress which lead to prosperity and success.

Here are arrayed those marvelous facts which make modern life and methods supreme in interest and importance. The fairy tales of the past, told to while away an idle hour with mysterious impossibilities, are outdone by the realities of the present. Here the true relations of all phases of human activity are shown, in their bearing upon the affairs of the world of to-day, so that the work becomes, in the highest sense, a book of new, fresh and accurate information.

To make more readily available such a wide variety of matter in a work of such extensive scope, it has been subdivided into five comprehensive books, all contained in a single volume.

Book I.—The Industrial Age.—We are manifestly in the midst of the Industrial Age, when every force of nature and every conception of the mind of mankind are being turned into such channels as will lead to greater industrial power. American enterprise is forging ahead into the world-markets so rapidly as to alarm the rival nations. Embodied here are all the facts of highest importance concerning the great undertakings of to-day, in these lines of activity. The methods, combinations and achievements of the money captains and the captains of industry are made clear. The railway, bank, manufacturing, lumbering, mining, stock-raising, meat-packing, shipping, and other interests which come into contact with all people, are depicted by graphic chapters and artistic illustrations.

In addition, such recent triumphs of inventive genius as are just passing over the line that divides the scientific discovery from the practical industry, are treated with special fullness and care.

Book II.—The World's Science and Invention.—No longer do great men, making triumphant discoveries in the realm of science and invention, have to fight for recognition, as did Galileo of old and many a man of more recent time. Instead, the world is eager to welcome advance in these, as truly as in other directions. The great captains of industry have enlisted with them the masters of science, and the world moves faster in its progress as a result of the powerful alliance. Here are gathered such triumphs of science, invention and discovery as are most significant in their universal interest to-day. The navigation of the air, the development of the automobile, the applications of electricity, the wonderful machinery created by inventive genius and utilized in the great industries, all these and a host of other kindred topics are included, with a multitude of valuable illustrations accompanying the graphic descriptive text.

Book III.—Marvelous Peculiarities and Noteworthy Facts of All Nations and Countries of the World.—In this age no man nor no country can live in absolute independence of all others. The interests of all mankind are so closely interwoven the world over, that what affects conditions in one land has its effect even to the antipodes. So it becomes of the highest importance to be fully informed of our neighbor nations near and far, their peculiarities, their industries, and the facts of interest and significance about them. In this splendid volume the whole world is viewed in the light of modern life and progress, to discover the relations of industry, commerce, natural conditions, history and travel in every land.

Book IV.—Amazing Wonders of Nature.—Contrasting vividly with the industrial and intellectual triumphs of man in the present age of the world, are the eternal works of nature. Here these wonders are depicted by graphic description and artistic illustration. From the glaciers of the Arctic regions to the earthquakes and volcanoes of the Tropics, the most important and interesting subjects are here treated in this limitless field of inquiry. In every instance the newest discoveries in the realm of natural science, bearing on the phenomenal facts of the planet which is our home, are recorded and explained here.

Book V.—Things We All Should Know.—Under this broad classification have been gathered a multitude of subjects and selected information of the utmost value. The list includes such topics as legal facts and forms, medicine and the prolongation of life, civil service, athletic sports, military, religious, commercial, geographical and other statistics, and a mass of general knowledge, both technical and popular, concerning which all need be informed.

To the foregoing array of facts included, must be added a mention of the hundreds of selected photographic illustrations of modern conditions in the industries and the life of the world to-day. Finally, the arrangement of the matter and the comprehensive indexing of the volume are such as to make the whole readily and promptly convenient for immediate reference and use on any subject. With the assurance that by its timeliness and its merit the work will win a wide welcome from the reading public, it is offered for consideration by

THE PUBLISHERS.

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INTRODUCTION

THE PROGRESS AND TENDENCIES OF CIVILIZATION

This is the Industrial Age, the age of triumphant knowledge. Follow the records of mankind down through all the centuries, scrutinize the achievements of the race, and more and more conspicuous becomes the fact that in no other period of the world have such marvelous advances in material and industrial progress been made. Within the last decade we have seen a dozen inventions and discoveries, any one of which would be sufficient to illuminate a whole century of the Middle Ages.

The history of the planet is recorded in the eternal hills themselves, and the mighty phenomena of nature. The history of man is shown in his works. From the days of the cave and cliff dwellers, the days of stone hatchets and bronze tools, the days of primitive life and primitive emotions, we have come to a day when the race is housed and fed and clothed and enlightened as never before, with improvement still a constant tendency. A palace in medieval times did not contain the genuine comforts of a mechanic's home of to-day. A British monarch two centuries ago could not have half the real conveniences or the luxuries at his command that are readily in the possession of any modern American householder. So it is of high interest to examine the tendencies of to-day, to discover the drift of society and industry, to observe the sources and the methods of the amazing activities that are enthroned in our high places.

We are taught by the records of man and nature that in the beginnings of the race, individualism ruled. Every man's hand was for himself and against all others. Food, shelter and safety from attack were the only demands made by primitive man, and for those things he strove. Out of individualism developed the first forms of social organization, stimulated by the discovery that in union was strength. In other words, man could better provide food, shelter and defense by joining with his neighbors than by opposing them. The growth of society from this nucleus was logical and natural. The history of civilization is one of the most interesting and important subjects for the attention of students, but even a summary is forbidden here by the limitation of space. Through individualism, primitive society, and organized competition, we have reached the conditions now in effect.

The conspicuous tendency ruling to-day is the consolidation of enormous commercial, industrial, and financial powers, into what we characterize as "monopolies," "syndicates," and "trusts." But even the trust itself, in its most extreme form, is

merely a natural outgrowth of conditions long developing. There is no essential difference in principle between the great department store of the metropolis and the general store of the country crossroads. Size is the only vital distinction. The village banker embodies all the characteristics of the money captain of Wall Street, except that of magnitude. The owner of the transfer line which carries passengers and their baggage from railway to hotel is a transportation magnate on a smaller scale. Any man who has goods which another wants, and holds up the price therefor to the limit of his customer's ability and willingness to pay, is illustrating the principles of monopoly. And so it is through all our relations, that the parallels of the monopolies, the syndicates and the trusts may be found, be they small or large.

Broadly speaking, any form of organization which economizes labor and produces a given result with the least demands upon man and material, is good. The surplus thus released becomes available for other service, and the general tendency is toward a broadening of industry and opportunity. This is not less true because in many instances the process of readjustment is a painful one, bringing hardship to individuals or classes. Nor is it controverted by the fact that monopolies and their kin are sometimes oppressive, claiming for themselves all the benefits of economized labor and material that should accrue to the public they serve.

It is beyond question that the telegraph service of the country is more adequate and efficient, to the advantage of every patron, consolidated as it is, than if it were scattered among a score or a hundred small companies, each confined to a certain district, or all competing for trade in every community. And yet it may be retorted with some reason that it is just as truly an extravagance of labor and equipment for three milk wagons to traverse a given neighborhood at the same time every day, each serving one-third of the householders, when one could do it just as well, thus leaving the surplus men, wagons and horses to some employment actually productive. If closely parallel lines of railway, each requiring to earn interest and profits, are an improper drain on the country they traverse, where one would serve all purposes equally well, in less degree the same is true of parallel routes for the milk wagons. It is a long line of query thus opened up.

Inventions have had to face opposition throughout the whole history of the world, even until to-day. The self-binding reaper was one of the triumphs of modern invention in the mechanical field, but it was riotously assailed as revolutionary and disastrous to industry by mobs of agricultural laborers who saw their occupation vanishing. Yet the broad prairies of the Mississippi valley have been brought under cultivation, and homes and employment have been created for millions, by the improvement in agricultural machinery. The typesetting machine was opposed because one would do the work

of several hand compositors, and many men would be discharged, but newspapers have multiplied and enlarged by its introduction, and the whole craft has ultimately benefited thereby.

Let the reader meditate on these conditions, thus briefly suggested, and reason out for himself the lessons of the fundamental principles involved. We are living in the Industrial Age, with all that is signified by the phrase, an age in which expansion and consolidation go hand in hand. The amazing progress of invention and discovery helps to make more rapid the development of the dominant tendencies. Great movements become conspicuous, and drawing attention as they do, they are the objects of scrutiny to discover wherein things may be made better. Already the trusts are the subject of controversy as to whether they are good or bad. Their friends declare that they serve the public better than it has been served before. Their enemies declare that the trust powers reserve for their own profit all the benefits that should be general. One radical may demand the disintegration of the trusts; another may see in them organizations which could be taken into public ownership with the utmost ease. Some thoughtful men observe evidences of a return toward individualism of a modern type, not the reign of contention such as ruled in the childhood of the race, but something higher and better.

Manual training and true domestic science are having their influence already, and this training is destined to exert a transforming influence in the social and economic life of the people, if the prophecies of students in these great fields are to be accepted. Before the Industrial Art League of Chicago, a famous preacher and sociologist, after speaking of the rapid substitution of electricity for steam-power and the possibility of carrying to an indefinite number of shops and factories the new power—it may be transmitted to a residence and employed for running a sewing machine or a dishwasher—said: “The factory system of to-day will become unnecessary, and into every house power can be brought which will drive each wheel for the artisan in his own little workshop. The masses, which are causing the students of sociology so much study, will disintegrate until they become not independent, but interdependent artisans, artists in their work, who shall have the opportunity to develop the best within them.”

There is romance even in statistics when one seeks the lessons behind the figures. It is a startling array of facts which one finds in the bulletin on manufactures issued by the United States Government, out of the census returns of 1900. The total value of manufactured products in the United States during the year 1900 reached the stupendous sum of \$13,000,000,000. This was an increase of 39 per cent over 1890.

In 1890, however, there was increase of 74 per cent over 1880; in 1880 an increase of 27 per cent over 1870; in 1870 an increase of 124 per cent over 1860; and in 1860 an increase of 85 per cent over 1850. It will be seen, therefore, that the increase from

1890 to 1900 was not abnormal. When one turns to the individual items which together form the total of manufactured products, one is struck with the fact that the iron and steel industry, though a colossus, is not the only colossus in the country. The value of the iron and steel product in 1900 was \$835,000,000. Compare with this the value of the products with which men clothe themselves. Textiles amounted to \$966,000,000; boots and shoes to \$261,000,000; a total of \$1,227,000,000. Consider also the industries which are concerned with the preparation of food and drink. Slaughtering products amounted to \$736,000,000; flouring and grist mill products to \$560,000,000; liquors, vinous, malt, and spirituous, to \$340,000,000; cheese, butter and condensed milk to \$131,000,000; a total of \$1,767,000,000. It appears, then, that in 1900 the consumer took thought of what he should eat and what he should drink and where-withal he should be clothed, to the extent of just about \$3,000,000,000. His demand for iron and steel was not much more than one-fourth that sum.

Perhaps, however, the most interesting deduction that can be made from the bulletin on manufactures is concerned not so much with products themselves as with productivity. The capacity to produce is increasing. If we take the half century from 1850 to 1900, the population has increased about two and a quarter fold. Meanwhile, wage-earners have increased about five and a half fold; wages about ten fold; capital about nineteen fold, and the value of product about thirteen fold. It is evident that the productive capacity of the people of the United States is increasing rapidly with the improvement of machinery and the more extended investment of the capital. It is the conclusion of the chief statistician for manufactures that "the apparent value of products per wage-earner has increased from \$1,065 to \$2,451 in 1900."

It is these significant facts and others akin to them that justify the characterization that this is the Industrial Age, the age of triumphant knowledge.

HOW CIVILIZATION HAS DEVELOPED

Let us note now, briefly, the history and progress of civilization, illustrating these fundamental principles that have led us to the Industrial Age of to-day.

Civilization has developed to its present high standard through the ability of man to acquire, retain and use knowledge. The brute creation is not perceptibly better qualified mentally at this time than it was when the first records of men were made. The reason is that brutes acquire nothing beyond their instincts except what is within their own experience, received within the narrow bound of their activity and in the small space of time through which they live.

Man classifies, specializes, accumulates, and saves from all parts of the earth and for

all time. One person is thus enabled to make use of the achievements of all and all may profit by the labors of every one. Thus civilization has the advantage of the composite mind of the entire human race and such a vast mental force with countless eyes and ears for new things, must by necessity continue to advance.

In other words, civilization is a mental universe consisting of suns, stars, planets and satellites in a process of evolution wherein the fittest survive and the least worthy perish. Civilization is therefore the establishment of social order in the place of individual independence and the lawlessness of barbarous life. It exists in as many degrees as there are communities or nations, and it is susceptible to continuous progress on up to the perfectibility of man. Sometimes the progress is in one direction, then it sways over to another. At various stages it makes different objects the principal aim, and where the preservation is complete it never recedes or retrogrades in its general advance. In time of war, patriotism is the chief virtue; in occasions of distress, charity; in periods of national defeat, humility, and so with people as with individuals, the progress toward perfection is largely emotional, but what is gained is not lost.

Civilization has been defined as the discovery and gratification of human needs; in other words, the multiplication of wants. It is not solely the organization of society, for organization is but the house in which society lives. The whole man is not contained within any organization, for states perish and man endeavors to fit himself for a life beyond it all. There has always been the struggle of ideals as to whether civilization should exalt the people, the church or the state. This has given rise to the many political sects and cults. In every case there has been a leader of great enthusiasm and ability to advance the standard of a given idea, and set it firmly in the forefield of civilization. In general, the term civilization designates the condition and powers of society as to its industrial, ethical and educational well-being.

Far back of the ability of man to make records of his thoughts or achievements the mutual dependence of man made it necessary for him to form social communities either to ward off the encroachments of enemies or to satisfy the ambition of some primitive warrior or statesman. The social community began with the Jews in prehistoric times with the family and its patriarch. Likewise in Scotland the original nucleus of civilization was the clan with its chief.

Buckle in his "History of Civilization" sets forth the following principles as governing the development of civilization:

1. Free-will rests on the erroneous belief in the infallibility of consciousness, since statistics prove that human actions, development and progress are governed by laws as fixed and regular as those which rule in the physical world.

2. The favorable relation of climate, soil, food, and the aspects of nature, are the

principal causes of intellectual progress, in which man may become stronger than nature and manipulate it to his own advantage.

3. Moral agencies everywhere sum up about an average and are very stationary, while intellectual activity is varying, advancing and of perpetual accumulating power.

4. The value of intellectual advancement depends upon its being grounded in the common morality, therefore religion, literature and government are not the causes, but the expression of civilization.

5. Civilization advances with the disposition to doubt and to investigate.

Laurent and other writers, especially the theologians, hold that the advancement of civilization is the result of the direct influence of a Supreme and Infinite Intelligence.

Guizot, one of the greatest of writers, presents no material or theological theory, but attributes the growth of civilization to the nature of individual and social development through the accumulating of useful material, as the tree might develop could it study and provide for its own wants. The greatest factors in the line of progress he believes to be the church, the crusades, the feudal system, the free cities, growth of monarchies and the reformation. In material things, the invention of gunpowder, of printing and of the uses of steam have made possible otherwise unthought of achievements.

Only in movement has there been progress. Such nations as India, Egypt and China have kept to the past, unchangeable, while the turmoil and struggles of the West developed the nations to their highest capabilities. No one can read ancient history without being struck with the strange progress and ruins of nations from migrations and conquests. The Scythians flow into southern and western Asia like a great flood, overcoming everything in their way, and long after that the Turks almost succeed in doing the same thing for Europe. Greece, Rome, Spain and France take turns in the conquest of the world. The discovery, exploration and colonization of unknown portions of the earth, the greed for gold, the rise of great cities, the creation of great manufactories by invention, the consequent incentive to industry and commerce, are all in the line of development that lead up to our present systems of order and law.

With the rise and establishment of modern nations on their present basis of national organization came security in personal achievements and possessions, and in this the individual found his self improvement and the people their present advancement.

THE ORDER OF SOCIAL EVOLUTION

Here then is the order of evolution: First the simple, next the complex, finally a return to the simple. Never a backward step is this last; merely a correction of the errors of the primary state, which was in principle right, but in many of its methods

wrong. Having in mind this orderly procession of development, and considering existing conditions, we recognize the present as the moment of the greatest and most complex organization in the world's history. The trust is, indeed, the natural evolutionary product of the capitalistic side, and the trade union, forced into existence to meet it, is the natural result also of conditions in the labor world. Both are top-heavy, both in the ultimate are menacing to the world's peace and prosperity, both aim to destroy individual initiative and personal liberty and responsibility. In the nature of things this condition of things will not long endure. That the change will come quickly, however, is not possible. Just as the development of the trust and union have been step by step, one thing leading to another, and covering a long period of time, so will be their disintegration, and the development of that fine individual life which shall make for a more social life, be brought about step by step. The hopeful fact is that it is coming as surely as the sun will shine on the morrow, and through laws as immutable as those which govern the movements of the spheres and compel the sun to give to the earth its light and warmth. Such a thought and an abiding faith in its ultimate materialization must give new hope and courage to the world.

And if we turn to the farm, we find this condition already largely in existence. It cannot work out perfectly there, of course, so long as we are so far from its realization in other directions; for man liveth not to himself alone, but is bound up in the social bundle in such a way as to make it impossible for him to extricate himself. And it is a wise providence that this is so. Yet the farmer more nearly typifies the ideal here presented, than any other calling to-day. Let him not surrender one jot or tittle of his splendid heritage of independence. Let him not be lured by the false lights of wealth quickly acquired, to leave his farm home for the glittering bauble of city life and city loss and decadence. The independent man to-day, that is, the man of largest independence, is the farmer who finds his living on the farm and his profits in whatever surplus products he may raise. With the telephone, with the extension of the electric railway, with the better local school and the agricultural college, with all these beneficent aids reaching out to him, the social life of the farmer is becoming year by year more ideal. He is to-day the dividing line between the old and the new, between the simple and the complex in the economic world. The least disturbed by the tremendous changes involved in the trustification of business, he also will fall the most naturally into the new order when we return once more to the path which makes the strong individual and leads to a purer society. How great a factor he may be in the world's uplift depends wholly upon the manner in which he shall employ his transcendent opportunities.

Great inventions and discoveries mark the real epochs of civilization far more truly than do the wars of the nations or the reigns of powerful monarchs. Marshalled here in

chronological order are indicated the greatest of these noteworthy achievements of human genius and energy, a significant array of evidence of the progress of man from the days of the childhood of the race to this Industrial Age of to-day.

GREATEST DISCOVERIES AND INVENTIONS

Alphabet of letters attributed to the Phœnicians.

Iron anchors originated with the Greeks.

Manufacture of glass by Phœnicians and Chinese.

Second Century—First European manufacturing of glass in Normandy.

Third Century—Specific gravity by Archimedes.

Seventh Century—Sun dial by Anaximander.

Twelfth Century—The compass by an Italian. Used centuries before by Chinese.

1320—Gunpowder by Schwarz. A crude form used in 1280 by the Moors and long before by the Chinese.

1422—Printing by Lawrence Coster.

1438—Metal types by Gutenberg.

1543—Copernican System of Astronomy, the basis of present astronomical knowledge.

1590—The microscope by Janssen.

1608—Telescope by Lippersheim.

1616—Circulation of blood by Harvey.

1640—Bayonets by Puseygur.

1643—Barometer by Torricelli.

1651—Electricity discovered and named by Dr. Gilbert.

1682—Laws of gravitation by Newton.

1705—Steam engine by Newcomen.

1720—Pianoforte by Cristofori.

1720—Thermometer by Fahrenheit.

1762—Chronometer by Harrison.

1767—Spinning jenny by Hargreaves.

1783—Balloon by the Montgolfier brothers.

1785—Weaving loom by Cartwright.

1785—Life boat by Lukin.

1793—Cotton gin by Whitney.

1796—Vaccination by Jenner.

1796—Lithography by Senefelder.

1807—Steamboat by Fulton.

- 1814—Locomotive by Stephenson.
- 1816—Safety lamp by Davy.
- 1817—Velocipede by Von Drais.
- 1824—Spectroscope by Kirchoff.
- 1828—Photography by Niepee.
- 1833—Guncotton by Bracounot.
- 1835—Telegraph by Morse.
- 1837—Phonography or "shorthand" by Isaac Pitman.
- 1840—Penny postage established by Sir Rowland Hill.
- 1841—Sewing machine by Elias Howe.
- 1847—Cylinder printing press by Richard Hoe.
- 1848—Chloroform by Simpson.
- 1858—Evolution by Charles Darwin.
- 1859—Bessemer steel by Bessemer.
- 1867—Typewriter by Sholes and Glidden.
- 1876—Telephone by Bell.
- 1878—Phonograph by Edison.
- 1879—Electric light by Edison.
- 1898—Liquid air by Tripler.
- 1899—Wireless telegraphy by Marconi.

THE WORLD AS IT IS TO-DAY

So much for the past. Now let us look at the present. In the volume presented herewith, it has been planned to put in the possession of the reader such an array of facts and information of genuinely educational character as would enable him to observe clearly the greatness of this industrial age and its tendencies. The methods and results of the great industrial and commercial undertakings of the world; the modern world of invention, discovery and scientific enlightenment; the more noteworthy works of nature which bear upon man and his achievements; the nations of the earth and the most conspicuous facts about them at the present moment, and a mass of matter concerning the things we need to know in every channel of human activity and interest—these are the general contents of the volume in hand.

The work is not a history, though it contains much of historical enlightenment. It is not an encyclopedia, though it contains an encyclopedic volume of information. Instead of these it is a book of the world to-day, of the Industrial Age, for reading, for reference, for education and for study. In it the mass of material has been so arranged

by a natural classification as to be readily at hand for convenient use for any purpose. Under the general heading of The Industrial Age are included accounts of the great commercial, manufacturing, industrial and financial undertakings which have risen so rapidly of late years. Their interesting phases are explained and pictured and the great cities of the world contribute to these pages.

The triumphs of modern science, invention and discovery are grouped in startling array, an evidence of the capacity of the human mind to encompass almost any achievement that genius suggests.

The world at large is moving with the spirit of this same Industrial Age. Its international relations are shifting, thanks to the influence of new political, military, and industrial conditions. Such facts are noted here about the peoples of the earth and the nations which they have established, as seem in each case most interesting to the reader or throwing light upon their present conditions and significant of their general characteristics. Sometimes this is a historical fact, sometimes commercial, sometimes personal. The very variety adds interest to the pages.

The works of nature, which outvie all the deeds of man, are an exhaustless field of inquiry and interest. Here such are selected as are commanding in their importance and of immediate interest at the present day for some special reason that brings them into prominence.

Finally, as a source of varied information of general scope, are included the multitude of subjects under the comprehensive heading, "Things we all should know," a treasury of facts sufficient to fill a whole volume, if in more expanded form.

With the assurance that this work will command and justify attention by its plan and execution, placing readily at hand as it does the information for which everyone is seeking in regard to the world, its conditions and its activities to-day, it is presented herewith to the reader.

Educational it is believed to be in the highest sense, in the real significance of the word. Going back to its derivation, to educate means not merely to present certain facts or to place a mass of knowledge at the command of the individual, but it means to lead him outward into the wider range of thought, to develop his mentality, to put in his possession a larger body of significant truths from which he shall be able to reason and deduce for himself the lessons and the tendencies of life. And so the information here compiled is intended to be of educational value to any thinking man.

It is unnecessary to suggest that in a work of such magnitude the editor has had recourse to extremely varied sources of information. Based on the fundamental purpose of having its facts brought up to the very latest possible moment, they had to be sought far and wide, sometimes in places little accessible to the usual reader. Encyclo-

pedic as the work is in many features and characteristics, it is not from the encyclopedias that its matter could be culled. Those ponderous and valuable works are necessarily years behind their publishers' dates in the contents of the volumes, and except in the unchangeable things of the world—and there do not appear to be many such nowadays—they must be supplemented by later information at the very time they are issued, if the reader is not to be led astray.

With the desire to occupy a field created for itself, and therefore peculiarly its own, the present work has kept timeliness in the foreground, and its pages are absolutely "up to date." The daily newspaper is the only printed matter against which a time comparison is never to be challenged.

Whatever measure of success has been achieved in the effort to produce a worthy work must be credited in common to the liberal scope on which it was planned by the publishers, the able editorial and literary assistance rendered by the specialists who shared in the writing and compilation of it, and the generosity invariably shown by all who were approached in the search for information or photographs which were needed to assist the undertaking. It is a pleasure, no less than an obligation, to acknowledge these essential aids with the utmost cordiality. Rarely, if ever, has such a noteworthy collection of views of the world's industries and industrial processes been gathered within a single volume, and the series of illustrations in the other divisions of the work are no less striking in their variety and the freshness of the subjects chosen. Energy and liberality on the part of the publishers and courteous co-operation on the part of many from whom rare and valuable photographs had to be obtained after considerable difficulty and expense, united to make such elaborate illustration possible.

In like manner the search for new and interesting facts, which, indeed, had to precede the quest for illustrations, met a hearty response from the men who know things and the men who do things all over the world. Most of the facts herein contained have been gathered at first hand from the original sources of information, by travel, by research or by interview, and from such sources may be accepted as accurate within the limitations of human imperfection. Where books or other printed matter contained facts that would serve in this connection they have been levied upon appreciatively for a share of their learning, adapted and modified to suit the present purposes. Such writings are properly included in the foregoing acknowledgments.

Now that the work is completed, it remains but to place it before the reader, with the desire that it may serve him well in the manner planned. That this desire may be realized is the earnest hope of

THE EDITOR.



GUGLIELMO MARCONI.
THE GENIUS WHO DEVELOPED WIRELESS TELEGRAPHY.

Marconi was born at Marzabotto, Italy, on April 17, 1875. From his Italian father, who was a land owner, he gets his name, Guglielmo, which he prefers to William, its English equivalent. His mother, however, was of Irish birth, and he speaks English as perfectly as he does Italian. Indeed, he has quite the appearance of an Englishman, and for a considerable part of his life his associations have been English.

Marconi was educated in Italian universities. He had not reached his majority when the idea of telegraphy without wires began to interest him, and he decided upon it as his special field of labor. His father's backing for the necessary outlay enabled him to carry on his experiments, and by April, 1899, he was ready to startle the world by sending messages across the English Channel. In October of the same year, the young scientist came to America to report the international yacht races between the Columbia and the Shamrock for the New York papers, and messages were flashed across space when both yachts and sending ship were enveloped in fogs and out of sight of land. By this time the inventor has taken out 132 patents in every civilized country of the world, which indicates in some degree the manifold details which he has had to consider in perfecting his appliances.

BOOK I

THE INDUSTRIAL AGE

WIRELESS TELEGRAPHY, A TRIUMPH OF MODERN DISCOVERY.

Today the traveler on a transatlantic steamship, far out in midocean, can write a message to his friends at home, hand it to an operator who sits at the side of a simple instrument in a cabin of the vessel, and for a few cents a word it will be transmitted across the intervening space, over the stormy sea, to a receiving station on shore, and thence by land telegraph wires to its destination, all with the speed of electricity.

It is only forty-three years since the announcement was made to an incredulous world that the Atlantic cable was a success and that telegraphic messages could be sent under the ocean from America to Europe. Many people remember the enthusiasm with which this amazing achievement was greeted, when the conviction was established that it was really true. Today the world is still enjoying the results of new scientific discoveries that are constantly being made, and the ones that seemed most marvelous when they were first announced, become commonplace after a

few years have passed. Most conspicuous of all the recent discoveries in science, and farthest reaching in its possible ultimate

effect upon our material affairs, is the successful system of wireless telegraphy, developed and established by the genius of the young inventor, Marconi. It was a triumph when his experiments resulted in communication at will without wires over distances of 250 miles. But hardly had the public become accustomed to this fact, when the announcement was made upon the authority of the young inventor himself, verified by unmistakable evidence, that on December 12, 1901, he had received signals across the Atlantic by this same system of wireless telegraphy. Wonderful as it was, the world has become so accustomed of late



GUGLIELMO MARCONI IN
WORKING CLOTHES.

years to scientific discoveries which, but a short time ago, would have seemed extravagant and impossible claims, that this announcement was promptly received as an accepted fact, incredulity existing hardly anywhere. The interested public

had long before learned that Mr. Marconi's announcements were never made until he was sure of his facts, and consequently people did not need to be reassured when this greatest wonder of all was announced. It was a red letter day in the history of scientific progress, that winter day in Newfoundland, and yet it was the direct result of a logical, persistent and

streams unconfined by wires, which can be quite as telegraphic as if they kept to paths of copper and steel. Discoveries suggesting this fact were made as long ago as 1842, and others looking in the same direction have followed. Marconi makes no claim to being the first to experiment along the lines which led to wireless telegraphy, or the first to signal for short distances with-



MARCONI AT HIS RECEIVING INSTRUMENT.

patient effort on the part of Marconi, the result of years of preparation, study, and experimentation, leading directly to the goal of his ambition.

Let us examine the process by which messages are thus transmitted through space without the aid of connecting wires through which they may pass. Those of us unfamiliar with electrical apparatus are accustomed to consider only such electrical streams as take their way along wires. But there are a great many other electric

streams unconfined by wires, which can be quite as telegraphic as if they kept to paths of copper and steel. Discoveries suggesting this fact were made as long ago as 1842, and others looking in the same direction have followed. Marconi makes no claim to being the first to experiment along the lines which led to wireless telegraphy, or the first to signal for short distances without wires. But in spite of his prompt acknowledgment to other workers in his field it has remained for Marconi to perfect a commercial system and put it into practical working order over great distances.

The two first essentials in wireless telegraphy, as Marconi has developed it, are the vertical wire, which he suspends in the open air to catch his messages, and the "coherer," which by its exquisite sensitiveness makes it possible to register the messages as

received. Electrical waves cannot be seen, but electricians have learned how to incite them, to a certain extent how to control them, and have devised cunning instruments which register their presence. These waves have long been utilized for sending messages through wires. Marconi started with the assumption that inasmuch as electrical waves may pass through the ether which fills all space as readily as through wires, if these waves could be controlled they would evidently convey messages as easily

as the wires. So he had to make an instrument which would produce a peculiar kind of wave, and another apparatus which would receive and register this wave at a distance from the first.

The transmitter which resulted from his experiments is an apparatus from which a current generated by a battery and passing in brilliant sparks between the two brass balls is radiated from a wire suspended on

but by the time the waves have passed over a long distance they are so weak that they could not, of themselves, operate an ordinary telegraphic system. It is here that Marconi utilizes the coherer as the final essential in the invention.

The coherer is a little tube of glass, about two inches long and as large as a small lead pencil in diameter. It is plugged at each end with silver, the plugs nearly meeting



MARCONI'S ASSISTANTS PREPARING TO RAISE THE KITE WHICH SUPPORTED THE RECEIVING WIRE.

(Marconi approaching from the left, indicated by an X.)

a tall pole. By shutting off and turning on this peculiar current the waves are so divided as to represent dots and dashes, and spell out letters in the ordinary Morse alphabet of telegraphy. The waves which come from the transmitter are received on a suspended wire, elevated either by a mast, a kite, or a balloon. This wire is exactly similar to the one used in the transmitter,

within the tube. The plugs are separated by a small quantity of nickel and silver filings, finely powdered. Under ordinary circumstances the filings are jumbled together like the particles of a sand heap, and in that state they form a poor conductor. The moment, however, that they receive an electrical wave they cling together tightly as a solid conducting bridge,



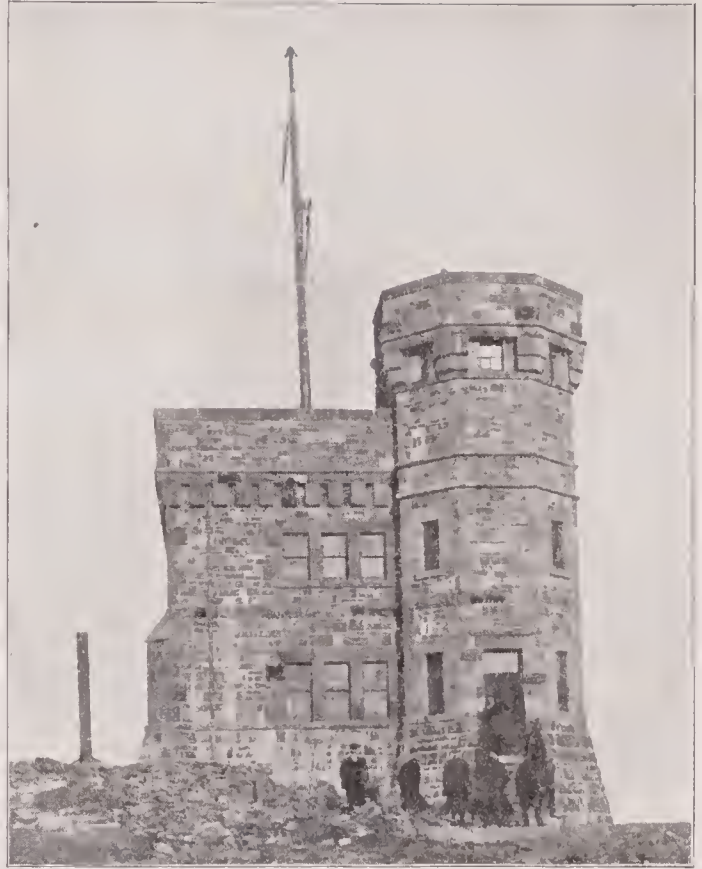
MARCONI WIRELESS TELEGRAPH STATION.

At such stations on the Atlantic coast, one of which is at Poldhu, Cornwall, the southwestern extremity of England, one in Nova Scotia, and one at Cape Cod, Massachusetts, the messages are received and transmitted and the experiments carried on. The masts are 210 feet high, and twenty of them are used in a fully-equipped station.

that carries a current from a local battery to a receiving telephone or a telegraphic sounder of common pattern. If it is connected at one end with the suspended wire, and at the other end with the Morse instrument, there is a dot or a dash printed, according to the signal that has been sent by the transmitter, miles away. Then a little tapper, actuated by the same current, strikes against the coherer, and the particles of metal are jarred apart, or decohered, becoming instantly a poor conductor, and thus stopping the strong current from the home-battery. Another wave comes through space, down the suspended wire, into the coherer, there drawing the particles again together, and another dot or dash is printed. All these processes are continued rapidly until a complete message is picked out on the tape.

In these early experiments Marconi believed that great distances could not be obtained without very high masts and long suspended wires, the greater the distance the taller the mast, on the theory that the waves were hindered by the curvature of the earth. But his later theory, substantiated by his experiments in Newfoundland, is that the waves follow around the earth, conforming to its curve, and it is not necessary, therefore, to erect masts to a great height. In the experiments of December, 1901, the transmitting station in England was fitted with twenty masts 210 feet high, each with its suspended wire, though not all of them were used. A current of electricity sufficient to operate 300 incandescent lamps was used.

Marconi landed at St. Johns, Newfoundland, December 6, 1901, ostensibly to communicate with the Cunard liners, traversing the North Atlantic Ocean, just along the



CABOT MEMORIAL TOWER.
Loaned by Newfoundland Government for Marconi's experiments.

Grand Banks. The dangers of the Newfoundland coast in the vicinity of Cape Race are well known to mariners, and it was supposed that his motive was to safeguard that coastline so that ships might be located when well at sea and kept in touch with as they approached there, thus reducing to a minimum the dangers of disasters. The Cunard vessels, like nearly all other Atlantic liners, are fitted with his apparatus.

Marconi brought with him an apparatus for the receiving of messages, but not for the sending of them, so no specially important experiments were expected by those not in his confidence. For elevating his long receiving wire he brought a balloon and some kites, which, with his other apparatus, he removed to Signal Hill to begin work. The Newfoundland Government placed at his disposal the Cabot Me-

morial Tower, recently erected on Signal Hill, where his appliances were immediately stored.

On Wednesday, December 11, he sent up his balloon, only to see it break away and sail off toward Labrador. The rest of his experiments were performed with wires hanging from kites, these kites being about nine feet square, and possessing a considerable lifting power. They were built of bamboo and silk, after the Baden-Powell model. By the time he had lost his fourteen-foot hydrogen balloon and one of the kites the wind died down sufficiently to permit a test, even though not under the most favorable conditions. Thursday, the 12th, was a blustery day, and it required the combined strength of the inventor and his assistants to hold the kite at the elevation of 400 feet, which was desired.

Before leaving England Marconi had given instructions to his assistants there for the transmission of a certain signal at a fixed time each day, beginning as soon as they received word that everything in St. John's was ready. The transmitting station was at Poldhu, Cornwall, the southwestern tip of England. Marconi cabled his assistants when to begin sending signals, and on that bleak winter's day, on the barren summit of Signal Hill, were received the distinct signals across the 1,800 miles of the great Atlantic. Again the next day the signals were repeated, and the experiment was an assured success. The storminess of the day and the consequent impossibility of maintaining the kite at a fixed elevation were handicaps difficult to overcome with the incomplete apparatus at hand. Nevertheless, there was no room for doubt that a signal had been actually transmitted from England to America without wires.

The reception which this wonderful achievement won, when after two days of self-restraint Marconi announced the fact, was memorable. The world wondered and awaited details. Edison accepted the fact as soon as Marconi issued a signed statement. The governor of Newfoundland reported the achievement at once to King Edward, and, most significant of all, the Atlantic Cable Company, which possessed a special charter and exclusive rights for telegraphic service in Newfoundland, demanded the cessation of experiments as an infringement upon its rights, a demand to which Marconi and the Newfoundland Government had to bow. After that the inventor made two or three journeys back and forth across the Atlantic to direct experiments and commercial negotiations, and a station for his transatlantic service was decided upon, to be located near Sydney, Cape Breton Island, Nova Scotia. Newfoundland thus lost for a time the distinction of being the scene of Marconi's further experiments. In addition to this receiving station there is a large one at Cape Cod, on the Massachusetts coast, and these two, with the Lizard station in Cornwall, will complete a triangular service conveniently located for commercial use in the transatlantic system.

Shortly after the transmission of these first signals from Cornwall to Newfoundland came the news of the transmission of entire messages for a distance of 1,551 miles. Marconi was crossing the Atlantic on the steamship Philadelphia, and he exchanged messages with his assistants on land for that distance. The officers of the vessel signed and certified the messages as they were received, and the last remnant of incredulity was banished. The messages

were clearly registered on the tape, and inasmuch as the receiver of the Philadelphia was not specially constructed for long distance work the achievement was considered all the greater.

Marconi's faith in his invention is boundless. He modestly but firmly maintains that what he has done is nothing with what he hopes to accomplish in the future. When the world throbbed with the surprise of his exploit, and the cables were loaded with congratulatory messages, he manifested no elation, but calmly declared that he never doubted his ability to employ the magnetic waves across the Atlantic. "When I am able," said he, "to send a message from Cornwall to New Zealand across the Isthmus of Panama, the only land that intervenes, then I shall count that I have accomplished something. The force I shall

generate shall be sufficient to send the signals the whole way. And there is an even more difficult proposition which I intend to tackle, more difficult because it involves transmission over land, with all the diversities of the different countries. I shall not rest until I have inaugurated wireless telegraphy between London and Calcutta, overland."

The imagination is overwhelmed in the effort to look forward to the possibilities of a perfected wireless telegraphy system. The \$400,000,000 invested in cable systems in various parts of the world would in large measure be lost. The cost of messages would be much reduced by this system. An Atlantic cable costs between \$3,000,000 and \$4,000,000, while wireless telegraphy stations can be built and equipped on both sides of the Atlantic for less than \$150,-



SIGNAL HILL, ST. JOHN'S HARBOR, NEWFOUNDLAND.
Showing the Cabot Memorial Tower from which Marconi conducted his experiments.

000, with a very small charge for maintenance. With all vessels and lighthouses equipped with apparatus, it should be possible to avert collisions at sea and wrecks on shore. In times of warfare generals may signal over the heads of the enemy where they could not possibly string telegraph wires or send couriers. The steamships in midocean would be in touch with the news of the day. It is little wonder that Lloyds, the chief marine exchange of the world, has contracted for fourteen years' use of the Marconi patents.

A general impression prevails that wireless telegraphy is still largely in the uncertain experimental stage, but as a matter of fact it is actually in wide commercial use. Most of the ships of the great navies of Europe, and all the important ocean liners, are now fitted with the wireless instruments. It is being used on many light ships, and the New York Herald receives daily reports from vessels at sea, communicating from a ship station off Nantucket. Though it is not generally known, messages are now received in England at the rate of $12\frac{1}{2}$ cents a word for transmission to vessels that have already sailed from port.

The one remaining element of doubt which has been suggested as to the practical uses of a world-wide system is dismissed by Marconi with the assurance that he already has proved that he can overcome it. This is the question of whether or not messages can be clandestinely read by those for whom they are intended; in other words, if privacy can be assured by a system in which the signals radiate with equal force in every direction from the point of

transmission. Marconi has found that he can so harmonize the transmitters and receivers or "tune" them, so to speak, so that they will respond to their own mates but not to others. By this system all the ships of a fleet can be provided with instruments tuned alike, so that they may communicate freely with each other without danger of the messages being read by the enemy. Great telegraph companies would have their instruments tuned to receive their own messages and no others. In one of Marconi's English experiments he had two receivers connected with the same wire, and tuned to different transmitters. Two messages were sent, one in English and one in French. Both were received at the same time, on the same wire, but one receiver rolled off its message in English, the other in French, without the least interruption.

With the progress of science as rapid as it is in these years at the beginning of the century one should be prepared for anything, however startling. Impossibility is a word to be avoided. Already wireless telephone systems are contemplated as a natural development to follow the wireless telegraph, and even these are hardly more wonderful than the phonograph with its manifold developments, the sending of pictures by telegraph, the moving picture machine under its various names, and a host of other scientific marvels which might be mentioned. Incredulity is no longer a safe frame of mind, and after the achievements of Marconi still less will we feel inclined to disbelieve any statement of invention or discovery.

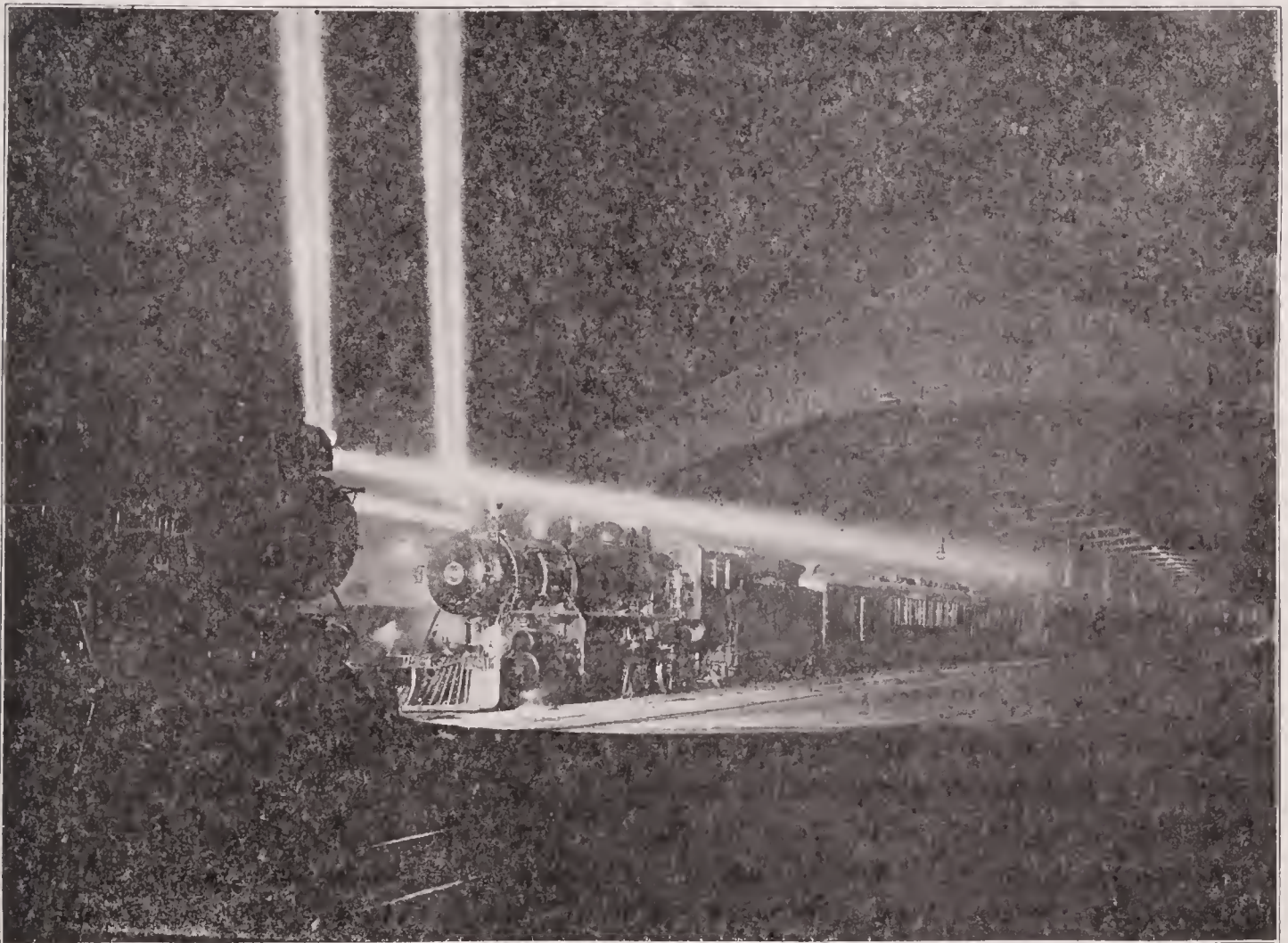
THE WORLD'S GREATEST INDUSTRY

THE RAILWAY

The combined length of the railways of the United States amounts to nearly 200,000 miles, and of the whole world to approximately 500,000 miles. The increase is at the rate of about 10,000 miles a year the world over. If the actual cost of construction and equipment, the production of the materials out of which the lines are built, the employees engaged in railway,

operation, and the interests which depend for their prosperity on the railway are considered, it may be safely said that the railway is the greatest industrial factor in the world today.

The most able financial organizations, the most skillful executives, and the most ingenious inventors, are devoting their attention to the construction, operation and



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SPECIAL TRAIN II. R. H. PRINCE HENRY OF PRUSSIA IN CHICAGO MILWAUKEE & ST. PAUL RAILWAY STATION AT MILWAUKEE, MARCH 4, 1902.

(Photo taken at 9 p. m. by the light of the searchlight headlights. This is the latest device for averting collisions, as the piercing rays can be seen for many miles along the track and flashing against the sky.)



Carrying night lanterns to the top of a railway signal post.

perfection of railway systems. Improvement in the modern railways over those of only a few years ago is conspicuous. Old roads are reconstructing their lines and new ones build with the utmost care to assure the permanency of their tracks, the economy of their administration and the comfort of

their travelers. Heavy steel rails have supplanted the light ones of iron; rock ballast is used where earth formerly sufficed; steel bridges span streams and the old wooden culverts are burned at the roadside; curves are straightened, grades are reduced, tunnels penetrate the mountains where trains formerly surmounted the summit by slow climbing. All this contributes to the safety, ease and speed of the journey, but it likewise reduces the cost of maintenance and operation, so that the railway companies find direct as well as indirect profit from their increasing expenditures. The elevation of tracks through cities, thus eliminating grade crossings, and the perfection of various block signals and safety switch systems, help to give additional safety to traffic and make high speed possible.



THE TRACK WALKER.

Rails, ties, switches and signals must be watched carefully to guard against accidents, and such patrol duty is one of the most important functions in railway service.

Train equipment has improved with the increase in travel, and today the railway journey may offer comforts and luxuries at a moderate price, which are hardly to be found in any but the homes of the wealthiest. A modern transcontinental train is in fact a luxurious home, with all the details

of a splendid clubhouse or hotel available, while one races across plains and mountains at high speed. Such trains, equipped with palace sleeping cars, dining cars, drawing room and observation cars, a library, barber shop, café, card room, music room, electric lights, and vestibules excluding the noise and dust as one passes from one car to another, with waiters, porters and a lady's maid ready to serve the passengers with everything demanded, add enticement to the prospect of a journey, where formerly the destination itself was the only reward.

It is not alone in the United States that railway construction is advancing rapidly and luxurious facilities for travel are provided. All over the world the same spirit of energy rules and the effort to connect remote lands by these arteries of commerce never ceases. On our own continent, our neighbors to the north and the south are active. One transcontinental line crosses Canada, a second is advancing rapidly, and



ALL ABOARD!

a railway to Hudson's Bay promises completion within a few years. The Mexican Republic has seen the construction of nearly 10,000 miles of railway within the last few years, and the country is traversed in every direction by lines which are extending rapidly.

Surveys have been completed for an intercontinental railway, to connect North and South America by way of the Isthmus of Panama. In South America the Andes Range has been a difficult obstacle for transcontinental lines to overcome, but already the mountains have been



SOLID COMFORT IN THE LIBRARY CAR.

penetrated from the Pacific coast by several lines, and a railway from ocean to ocean is a thing of the near future. The heart of the continent is penetrated by numerous lines in Argentine and Brazil, lines which afford an outlet for the immense production of the interior, and novel journeys for the inquiring traveler.

cept for its course across Northern Manchuria, in order to obtain a shorter route to the sea, the entire line is within the dominions of Russia, and Manchuria itself is so entirely dominated by Russian authority as to be virtually at the disposal of the railway.

On the Pacific the Siberian Railway and



OPERATOR IN THE SIGNAL TOWER.
(Showing mechanism by which switches and signals are controlled.)

In Asia the whole political and military situation has been affected by the construction of the Trans-Siberian railway, built by the Russian Government. Extending all the way from the European provinces of the empire as it does, across the whole of Asia, to a terminus on the Pacific Ocean, it provides a speedy route by which armies may be shifted to any scene of threatened difficulty at the will of the Emperor. Ex-

this connecting line, the Chinese Eastern Railway, have one terminus at Vladivostok and another at Port Arthur. The former is a Russian city, with an impregnable harbor on the coast north of Korea. Port Arthur was acquired by negotiations with the Chinese, and situated as it is at the gateway by which Peking must be approached, it becomes a sentinel port whence the Russians can watch their own inter-

ests. The entire length of this wonderful railway from the Ural Mountains to the Pacific, is nearly double that of an American transcontinental railway, or more than 6,000 miles, and it was constructed at a total cost, including all incidental expenses, of nearly \$250,000,000. From a European port on the Atlantic, Havre for instance, it is, therefore, possible to go by continuous connecting lines of railway a distance of nearly 10,000 miles right across two continents, or almost half way around the world. The Siberian line was not begun until 1891, and the completion of it in eleven years across the steppes of Siberia, the great rivers which flow through Asia into the Arctic Ocean, the mountain ranges and the wilderness, is the most noteworthy achievement in the history of railway construction.

Transcontinental trains on the Siberian Railway are equipped as our own railways are in America, with sleeping cars and dining cars of Russian patterns. In addition they have bathrooms, a gymnasium and a church car, which travels with the train at times, where priests hold services for the benefit of the faithful while they are speeding through the heart of Asia.

Russia has yet another railway, extending eastward into Asia from the Caspian Sea, about 1,000 miles south of the Siberian railway and roughly parallel with it. It has been completed for a distance of

about 1,500 miles, and thus reaches nearly to the western boundary of the Chinese Empire. At its terminus, this line is less than 500 miles from the northern terminus of the British railways in India, and if this gap could be traversed there would be continuous rail communication between Western Europe and Calcutta. The great mountain range called the Pamirs intervenes here, however, and the connection will have



IN THE DINING CAR.

to be made some day by an easier route, but little longer, across Afghanistan. It is the purpose of Russia to connect this railway with the Siberian line by a north-eastern extension, and perhaps, some day also, to build directly across the Chinese Empire to the Pacific Ocean at Shanghai.

Africa is not falling behind in the matter of railway construction. Already the line of the Cape to Cairo Railway is sufficiently advanced to make a striking impression when one studies the map. From Cape Town northward it has been completed nearly to the Zambezi River, and

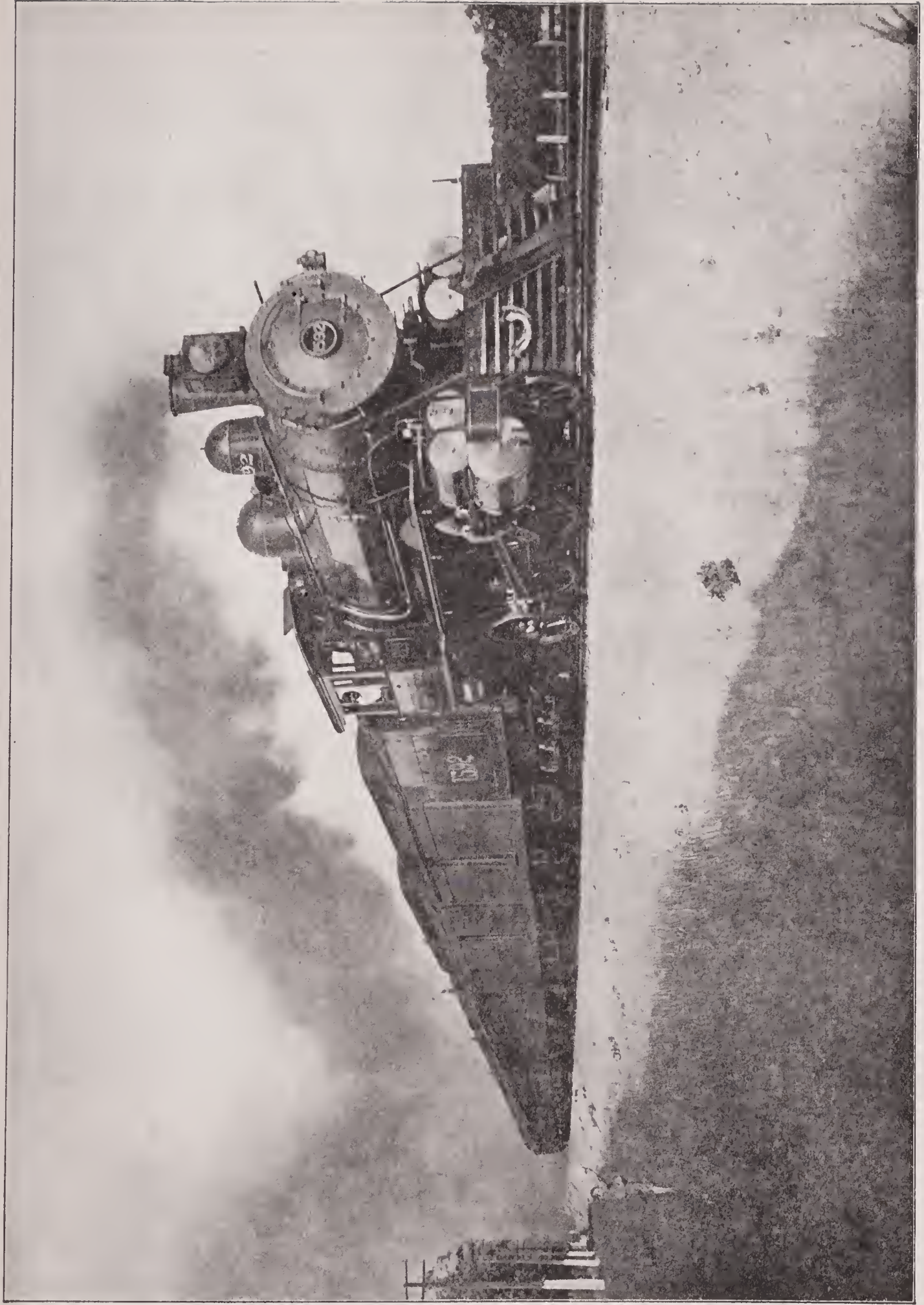
from Cairo it extends up the Nile to Khartum, whence construction is steadily advancing. The gap is still a long one, but the surveys are made, capitalists are interested, and it promises to be not many years before the traveler can find a through train of palace cars by which he may travel the length of the Dark Continent from the Cape of Good Hope to the Mediterranean. This is a distinctly English enterprise, and except for the comparatively short crossing of German East Africa, the line traverses British territory all the way until it reaches the practically British province of Egypt. In Western Africa, the French never halt in their explorations of the Sudan, into which they are steadily push-

ing their railways southward from Algeria. Before many years Timbuctoo will be a way station between Algiers and Dahomey, and we may visit the oases of Sahara in palace cars.

Australia, with its immense expanse of interior desert, is not yet traversed or encircled by a railway line. The capitals of the more populous states of the new Commonwealth, from Adelaide to Brisbane, are connected by rail, and many short lines extend from ports around the coast toward the interior of the continent. From Adelaide a telegraph line extends northward across the continent to Port Darwin, where it connects with the submarine cables to Asia and Europe. A railway line has been



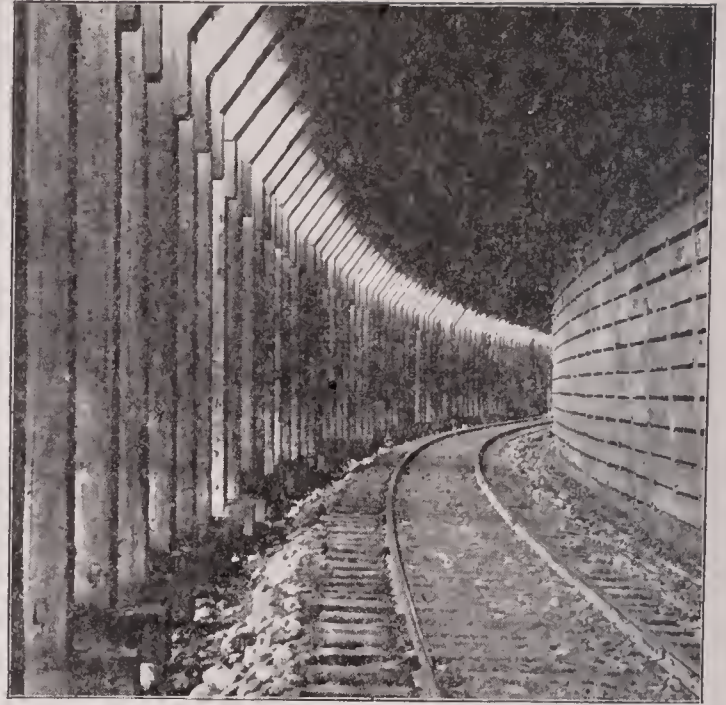
RAILWAY CONSTRUCTION IN THE MOUNTAINS.



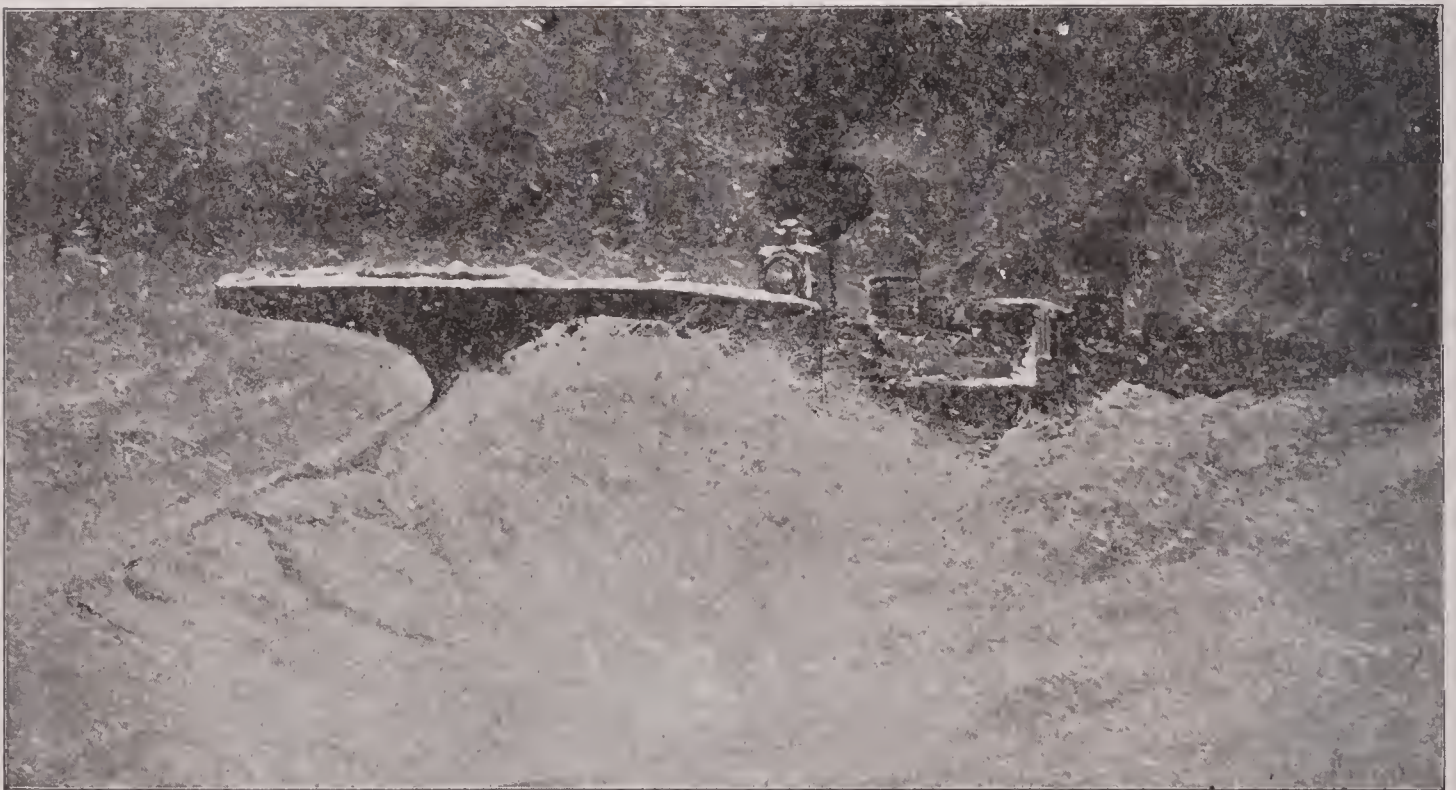
TRANSCONTINENTAL EXPRESS RUNNING SIXTY MILES AN HOUR.

This train took its own picture, by opening the lens of the camera, that had been made ready, as it ran over the connecting mechanism on the track.

built from Adelaide northward as far as Oodnadatta, 800 miles into the desert, but a train service operated once every three weeks each way has not been sufficiently profitable to encourage the extension of the line. From this desert to Brisbane in the far northeast, there is consequently continuous rail connection for some 3,000 miles. What the future may bring to this great undeveloped land of possibilities hardly realized can not be predicted, but it is certain that Australian energy will not fail to multiply railway lines as fast as industry would be profited thereby. The three northern continents are crossed by railway lines. The three of the south are yet to be traversed.



INTERIOR OF A RAILWAY SNOWSHED IN THE MOUNTAINS.



SNOW PLOW AT WORK IN THE ROCKY MOUNTAINS.

GREAT RAILWAY CONSOLIDATIONS



ACROSS THE CONTINENT.

One of the most noteworthy conditions of the present day is the tendency toward enormous consolidations of American railway lines in the control of a few individuals. Within the limits of the United States we have approximately 200,000 miles of railroads, and practically half that stupendous property is in the possession of five little groups of men, who direct it from their offices in New York.

It has taken less than seventy-five years for the railway systems of the United States to grow from that first inadequate little wooden track with its lonesome locomotive of 1829 to this mileage which is sufficient to make a single track extending eight times around the world. The increase of railway mileage in the United States at this time is nearly twelve miles a day. For every five miles of railway in the country there are twenty-five men at work, one locomotive, and eight cars. The number of railway employees increases at the rate of 240 new men every day. These American railways carry more freight than all the ships of all the oceans of the world, added to one-half the traffic of the Euro-

pean railways. One-fifteenth of all the labor in the United States derives its support directly or indirectly out of the railway industries. When we add to these facts the recollection that the success of almost every great American industry depends upon the railways in some way or other, whether it be manufacturing, commerce, or farming, it becomes apparent what vast importance railway problems have to all of us and to the prosperity of the country at large.

There is nothing new about the tendency toward consolidation of railway lines, except the rapidity and the magnitude of the recent achievements in that line. From the day when railways first began to be constructed smaller lines have been combined to establish greater ones, with the invariable result of improved service, and, at the same time, opposition to the combination. Half a century ago passengers had to change eight times between Albany and New York, and as many more between Albany and Buffalo, even though there were railways connecting through the entire distances. And yet the consolidation of these little lines, which now seem almost ridiculous to us, met with distinct opposition, both popular and legislative, when the first moves were made, just as is the case now in regard to the greater consolidations of today.

It seems fair to say that there is no essential evil in consolidation of railway systems as a principle. Such consolidations manifestly make for economy of administration and for convenience and harmony of service in the connecting lines.

These things and the reduced rates which should naturally follow are all to the public benefit. As a matter of fact, except for short periods and in specific instances, there has never been but little real competition between railway systems. They might compete in quality of service, but clandestine pools have usually protected them from the cost of a fight among themselves.

The real question, therefore, that comes from Americans in connection with the railway consolidation is whether the benefits of such union are enjoyed by the public, or are to be retained entirely as the sources of increasing wealth and power in the hands of the controlling syndicates. In the latter case it would seem as if the syndicate managers

were preparing for the inevitable result of public ownership. In the former case the public may rest as contented with the present relations as it has been in the past.

Five great syndicate interests, dominated in each case by one or two conspicuous men, control the five most important groups of railways in the United States. In addition to these, there are certain important independent lines, still outside of syndicate control, which are continually the subject of speculative rumor as to how or when they shall be absorbed.

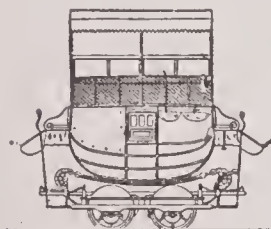
The most conspicuous of these groups, headed by the men who are today the most conspicuous, is the Morgan-Hill system, headed by J. Pierpont Morgan, the New York banker,



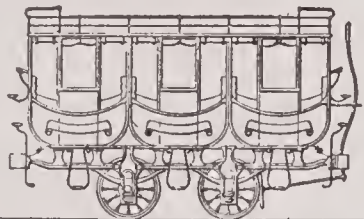
1825—First English Car on Record.



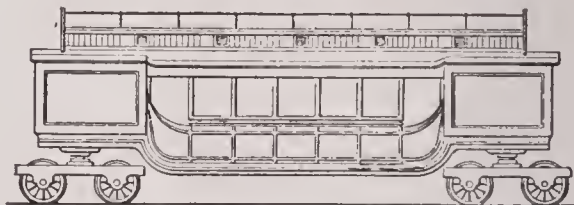
1829—Coach Body Car, the "Experiment," Stockton and Darlington R.R., England.



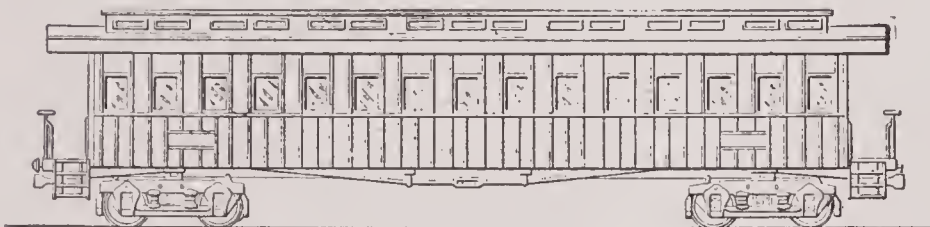
1830—The "Ohio," a Double Deck Coach Body Car, designed by Mr. Imlay for Baltimore & Ohio R.R.



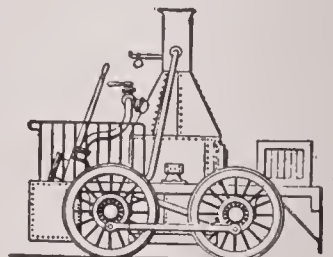
1831—A Triple Body Car on the Camden & Amboy R.R., designed by Mr. Green. Drawn by horses and the "John Bull."



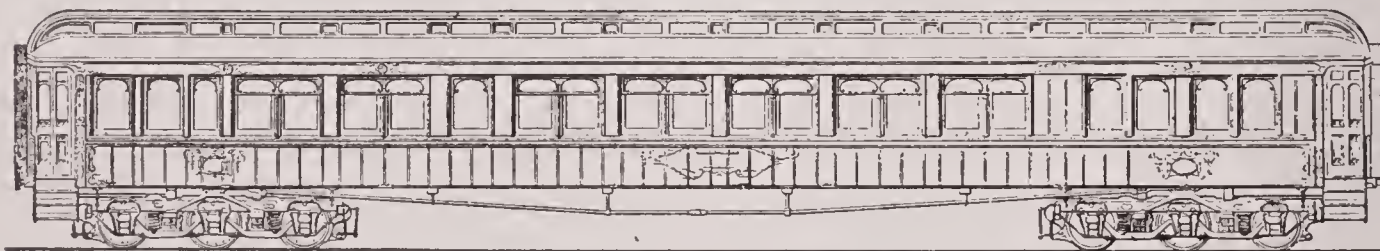
1836—The "Victory," also by Mr. Imlay. First car with raised roof. First car having toilet compartment and bar.



1865—A Typical Car of the Period on all the Roads. Length 50 feet, weight 35,000 pounds.



"Best Friend," 1830.



Late Sleeping Car. Length 72 feet, weight 100,000 pounds.

and James J. Hill of St. Paul, the northwestern railway magnate. The mileage which this combination controls measures a total of 37,500 miles, including two transcontinental lines from St. Paul to the Pacific coast, by the famous "merger" that brought on the attack made by the governors of the northwestern states and by the president of the United States in the federal courts to determine the validity of such

20,000 miles, including all of the New York Central lines, the Lake Shore and Michigan Southern, the Michigan Central, the Chicago and Northwestern, and the Big Four, with a host of tributaries, thus including three distinct lines between New York and Chicago.

The Pennsylvania system, with mileage approaching 15,000, now includes the Baltimore and Ohio, in addition to all of the



RAPID TRANSIT IN A GREAT CITY.

The Manhattan Elevated Railway in Upper New York. Height above ground nearly 100 feet.

union. The roads included in this system are the Northern Pacific, the Great Northern, the Chicago, Burlington and Quincy, the Erie, the Lehigh Valley, the Philadelphia and Reading, the Hocking Valley, the Southern Railway, and the Mobile and Ohio.

None of the other groups approaches this one in mileage, although in importance, wealth and profits they may not fall behind. The Vanderbilt system has a total of some

lines formerly identified with the Pennsylvania, including the Fort Wayne, the Vandalia, and the Panhandle.

The Gould-Rockefeller system, in which the Sage interests are also involved, includes the Missouri Pacific, the Wabash, the Iron Mountain, the Texas and Pacific, the Missouri, Kansas and Texas, and the Denver and Rio Grande, with a total mileage of nearly 17,000.

The Harriman-Kuhn-Loeb system, with

a mileage of 22,000, includes the Union Pacific, the Southern Pacific, the Oregon Short Line, the Chicago and Alton, the Illinois Central, and the Kansas City Southern. In addition to these syndicate systems of railways there still remain, as has been said, a number of independent systems with a total mileage of some 37,000, of which the Santa Fe, the Rock Island and the Chicago, Milwaukee and St. Paul are the most important. It is more than possible that several of these, particularly those of the southeastern states, will find a final refuge in the Morgan-Hill system or in some other syndicate organized for the purpose.

Says a recent student of this picturesque situation: "A strip of land hundreds of miles wide, beginning at the Washington ports in the northwest and sweeping east to the lakes, is practically an industrial fief of Mr. Hill and Mr. Morgan. In Mr. Hariman's hands, in some measure, is the prosperity of California and the southwestern states, as well as of a broad strip up the Mississippi Valley, a fertile band through the prairie states, and all the habitable land reaching west from the Rockies to the coast. The central Atlantic states live to the rhythm of the New York Central and the Pennsylvania Railroad. It is true that one

can go from Boston to San Francisco, from the Gulf to St. Paul, and travel not a mile on the roads of the railroad giants, but only through a very narrow path and for the most part within view of competing syndicate lines on either side. When it is remembered, furthermore, that Morgan men are directors in Vanderbilt roads, Hill men in Pennsylvania roads, Gould men in Hariman roads, and that every other possible interweaving of common control exists throughout the great groups, the lines of demarkation melt away."

And yet, within twenty years, the average rate of freight has decreased from a cent and a quarter a ton for each mile to a little over seven mills, and the tonnage has quadrupled. The passenger rate has likewise gone down, and passenger traffic is growing 15,000,000 a year. With all these picturesque conditions in effect the situation becomes a puzzling one, and it will be of the highest interest to watch the course of events for the next few years. Whether or not we are to return to a system of individual competitive roads, whether railways will be a private monopoly or a government monopoly, can only be known after the period of adjustment has passed and the public has taken its own hand in the settlement of the proposition.

THE GREATEST FREIGHT TRANSFER YARDS IN THE WORLD.

Any enterprise which promotes economy in the shipping and transfer of freight carried by the railway systems of the United States is necessarily of interest to everyone. In the end such economy results in the reduction of cost of all commodities and the consequent profit to every consumer. One of the most interesting plans to facilitate the prompt exchange of traffic has been devised in the interest of the railways entering Chicago. It is a great distributing yard where all the freight cars of all the roads can be classified for their outgoing journeys, and it thus serves the same purpose in the world of traffic that the clearing-house does in the world of finance. The volume of traffic entering and leaving Chicago by rail is stupendous. Ten thousand cars of freight are handled in Chicago every day, and of this number sixty per cent are loaded with through freight or have entered the city on one railroad and must be transferred to another. Under the superseded system most of these 6,000 cars had to be hauled over fifteen miles of track in order to properly distribute them, and this in most instances caused a delay of a whole day in making the transfer. The usual system of breaking up trains and sorting cars is at best slow and unsatisfactory, and it often happens that a through car reaching the yards shortly after the company's transfer train has left is held several hours before it can be started out for the other road.

There are twenty trunk lines entering Chicago, and the vastness of any system of switching and classifying cars that could handle the business of all of them can

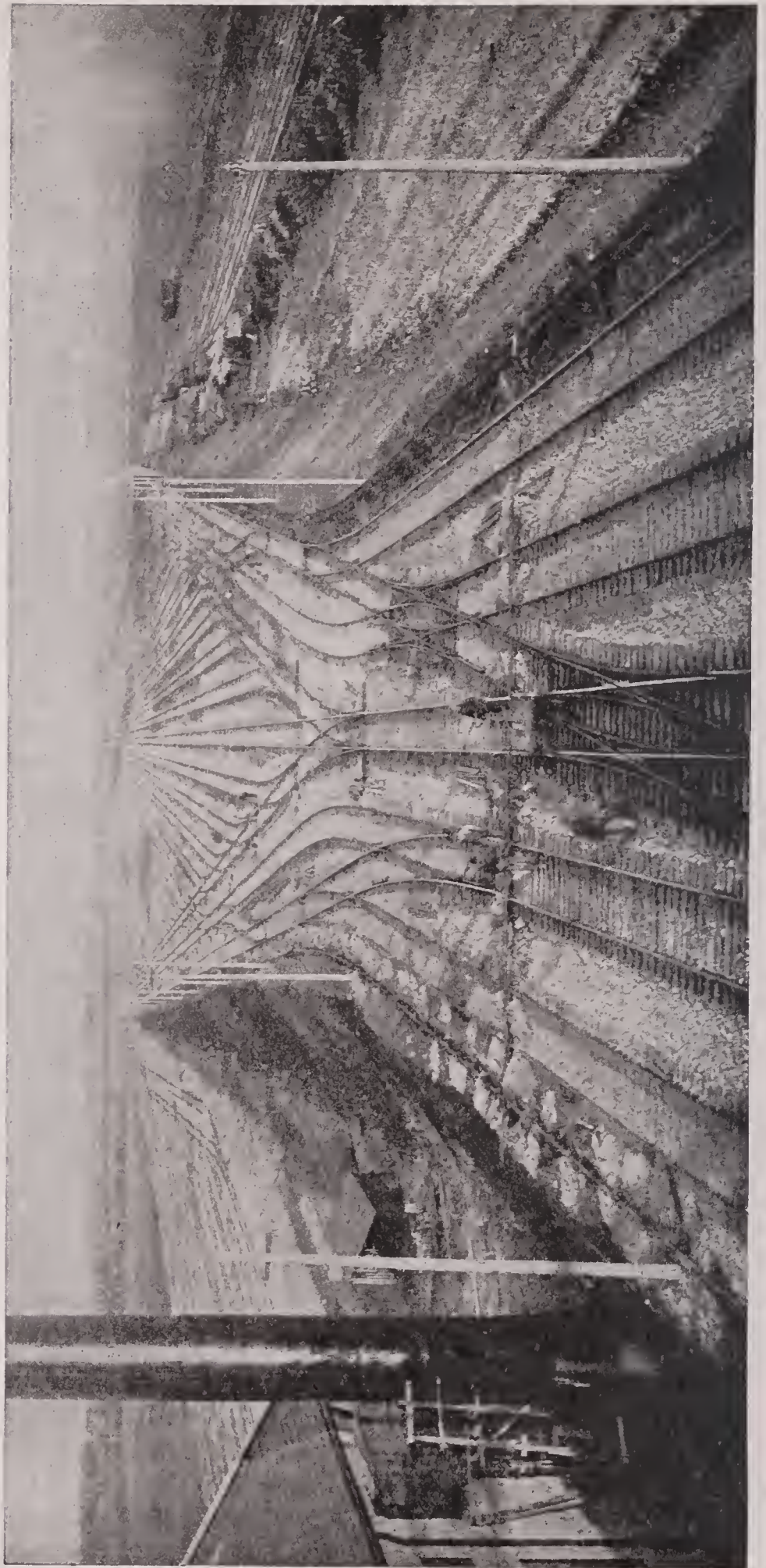
easily be appreciated. For years it has been done by the various belt lines that were compelled to operate a total of twenty-seven different yards, which are from a tenth of a mile to sixteen miles apart.

In order to obviate all of this duplicated labor and expense, a new system was perfected whereby the difficulties of the former plan have been overcome by centralizing the work in one immense clearing-yard. Under this arrangement it is claimed 8,000 cars can be switched and handled in a single day, and this is an important achievement to the managers of the railway companies, who had long realized the wastefulness of the ancient system. All of the railway lines entering Chicago united in a mutual organization for the purpose of establishing and operating these great yards, so that it was assured that they would make immediate use of the system as soon as it was completed.

The new clearing-yard is located west of Chicago, a few miles beyond the city limits, and is connected with three of the belt lines which encircle the city and communicate with all of the railways interested. The original plans for the undertaking were formed some years ago by President A. B. Stickney of the Chicago Great Western Railway, and a beginning was made at that time. From him the tract took its name of Stickney, but the work was interrupted before a great deal had been accomplished, and in the newer reorganization an entirely different plan was put into effect. The tract available for these great clearing yards is about two by five miles, but at the beginning not near all of this area was

be thus utilized. The first yard is 670 feet in width and 13,000 feet in length, its greater measurements being east and west. There is room for this yard to be duplicated as many times as may prove necessary with the growth of traffic in Chicago.

Extending along the whole length of the north and south boundaries there are three thoroughfare tracks, with double track "Y" connections at each end to the belt lines. Bisecting the yard, on an east and west line, is a central through track known as "track No. 25." There are two sets of classification tracks, known as the "classification yards." The tracks in these yards are 2,400 feet long and they extend the full width between the thoroughfare tracks. Midway between the two classification yards is an artificially constructed "gravity mound," and on each side of it and parallel to it on the level plain are sets of receiving tracks which are from 1,600 to 3,200 feet in length. The gravity mound has an elevation at its summit of $21\frac{1}{2}$ feet above the general level of the yard. For a short dis-



CHICAGO TRANSFER YARDS—LOOKING EAST FROM SIGNAL TOWER ON GRAVITY MOUND.

tance each side of the summit there is a grade of $1\frac{1}{2}$ per cent and then for a distance of 1,800 feet a grade of 0.9 per cent, and a grade of 0.5 per cent for a distance of 300 feet further, the foot of the gravity mound tracks being several hundred feet beyond the apex of the classification yards.

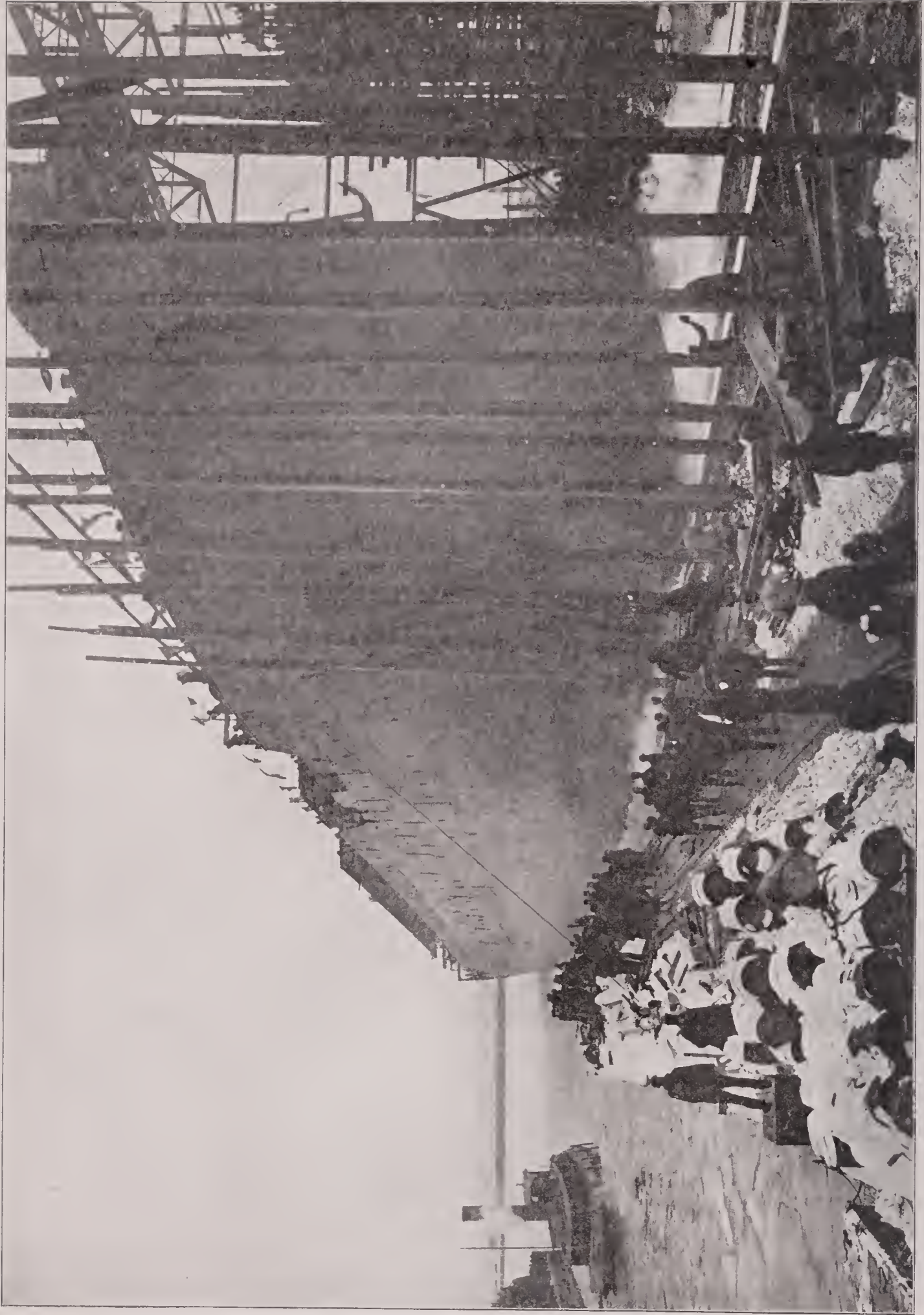
Running diagonally across the classification yards there are double "ladder tracks," and east and west of the classification tracks there are parallel overflow tracks, which extend parallel with the classification ladders at the outer end of the classification yards. Parallel with the double ladder at the inner ends of the classification tracks are two tracks, the one next to the ladder being a "poling" and the outer one a "drilling" track. The double ladders, which connect by switches with each track in the classification yard, converge at a three-throw switch into the central track, No. 25, already mentioned, which extends through the center of the whole yard. Consequently there extend over the summit of the gravity mound five parallel tracks with leader tracks and crossovers.

The object of the gravity mound is to allow the transfer of the various cars to the various classification tracks to be accomplished by gravity and save a great amount of engine mileage, which would necessarily be if the cars had to be pushed on to the various tracks by switching engines. The method of operation is as follows: A train coming in at either end of the yard is run into one of the receiving tracks, where the engine is uncoupled and takes back a made-up train from one of the classification tracks. One of the clearing-yard switching engines then couples on to the train, backs up and pushes it over one of the drilling tracks, which we have mentioned above as

lying alongside the classification ladder.

As the train is pushed up the summit the couplers are disconnected at the proper places in the train, and as the cars go over on to the down grade on the other side of the summit they separate from the train and run down on the central track, No. 25, to the three-throw switch at the apex of the classification ladder. Here they are switched to either side of the double ladder and finally into the desired track of the classification yard.

The great yards thus described were finished and ready for operation in the fall of 1902, and after that time all freight traffic entering and leaving Chicago passed through them for classification. In addition to the form of the enterprise as outlined, it is expected that a series of great warehouses will be built and placed at the disposal of the wholesale houses of Chicago, so that they may receive their shipments here at the clearing-yards and distribute them again to their customers without bringing them into the city proper. It is manifest that the establishment of such a system of warehouses will go far to relieve the streets of the city of the immense traffic that now congests them, and that every citizen will find himself profited thereby, and by the additional comfort and quiet of the streets. Furthermore, it is contemplated by the railway companies which have established this yard that the exceptional shipping facilities thus created will induce the location of large numbers of factories. From such a beginning, therefore, it is natural to expect the growth of a great industrial and manufacturing community that will be one of the more conspicuous features of the commercial development of the great city.



LAUNCH OF THE "KROONLAND," CRAMPS' SHIPYARDS, PHILADELPHIA.

This is a passenger and freight steamship for Atlantic service, 560 feet long and with engines of 10,000 horsepower.

THE AMERICAN INDUSTRIAL INVASION OF EUROPE

The American industrial invasion of foreign lands has reached such proportions as to disconcert and even alarm many thoughtful men abroad, who see their countries being exploited for American profit and their opportunities utilized by American energy. American industrial pioneers are entering the activities of Europe, Asia and Africa, in competition with the English, French, Germans and Belgians, who have believed themselves to be safe in their monopoly of their respective fields of endeavor.

Even in London, an English builder, manufacturer, engineer or promoter finds his American rivals at every turn. Great American manufactories are establishing branches in England, and in some instances actually buying out their former English competitors. In 1901, the British match-manufactories were absorbed by the American match trust, a fact which greatly disturbed English students of commercial and industrial conditions.

A striking achievement was made a year later by an American builder, who practically completed in ten months a huge work that the most enterprising of British contractors declared could not be done in less than five years. He shook the traditions of British bricklayers, carpenters, builders and theorists to their foundations. The London Times devoted one of its ponderous editorial columns to a lesson to the British workmen, based on this American contractor's success, and other papers all over the British Isles took up the refrain.

The British Westinghouse Company, which was to supply the electric fittings for most of the underground railways that American capitalists were building in London, found it necessary to erect one of the greatest electrical plants in the world at Manchester. Being to all intents and purposes a British company, they were naturally very anxious to give the British contractors the job of building it. A Manchester company got the contract for foundations, and a London company for the steel work, both these contracts being allotted in May, 1900. Neither of the concerns could "see their way" to saying when the work was likely to be done. The foundation people thought the matter over and finally began the work in July. In November the foundation of one of the largest buildings was in such condition that the steel work could be begun, and then the London contractors arrived on the scene and the work proceeded in an eminently dignified way.

Meanwhile the capitalists were making things hum, extending their systems right and left, pushing through plans for the electrification of old-fashioned steam lines with such rapidity that it made the old-fashioned stockholders dizzy to think about, and pouring huge hurry-up orders on the Westinghouse Company.

At the gait things were going the new plant would not be ready in time to fill the orders, and the great enterprise would be delayed, at a cost that might be disastrous. George Westinghouse promptly took a hand in it, and told the contractors

that the whole group of buildings must be ready in two and a half years. The contractors threw up their hands in holy horror. It couldn't be done in less than five. No man on earth could do it in less than five.

The situation was serious, for it was beginning to look as if even two and one-half years was going to be too long to wait. Then somebody called to mind the doings of an American contractor named Stewart, head of the firm of J. C. & A. M. Stewart, of St. Louis, Pittsburg and New Orleans, who had taken in hand the principal building of the Pittsburg Exposition when it had burned down three months before the day the show was to open. Stewart had it up again and finished ahead of time. His rush work on some grain elevators was so striking that a novel had been based upon it. He had restored the Galveston system of docks and storehouses in forty-five days from the time they were destroyed.

The Westinghouse people told Stewart they wanted him to take the Manchester job, and finish it in fifteen months. The agreement was signed in Pittsburg, and the contractor took the first steamer for Liverpool. He had never been in England before, and did not know what was waiting for him. He landed on January 24. One week later his best two men got four hours' notice to start for England. One of them was in New Orleans and the other in Toledo, O., but they both caught the Teutonic two days after. Before they could reach England, however, Stewart was hustling home aboard the Oceanic. The two men stopped at Queenstown, hired a tender and went out to meet the Oceanic, and had a bundle of minute instructions as big as a log of wood tossed to them. The

next day they were at the Manchester works, and things had begun to happen.

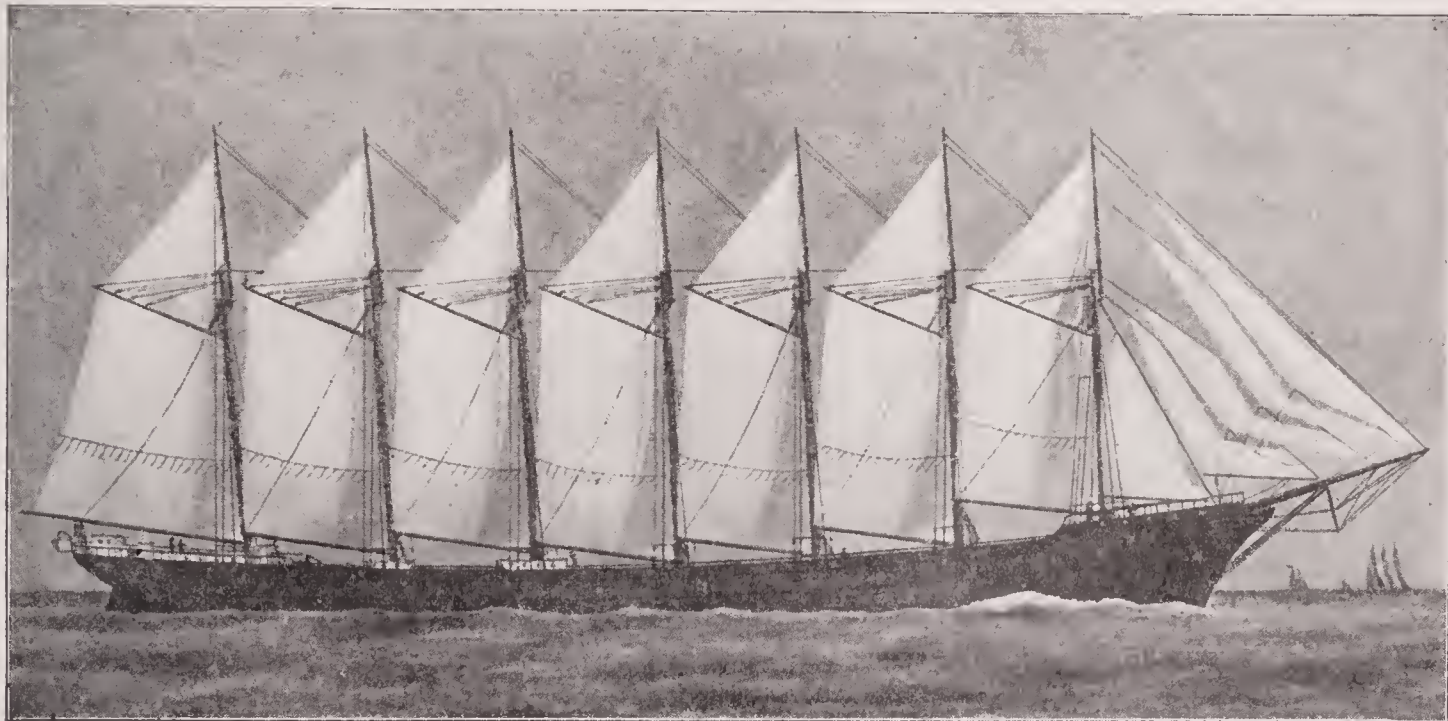
Three weeks later, Stewart, who had been collecting some of his good men, and buying American appliances for handling work, was back in Manchester. He brought ten young Americans, whom he had trained himself, and with them he sailed into the biggest fight of his life. For the next few weeks he and his little band got about four hours' sleep per night. They "rushed" things all day and spent half the night in discussing how they were to be rushed the next day. Stewart slept in a little hotel within a hundred yards of the work. His two men slept on the plans in the office. They were working every morning at six.

When the American took charge of affairs at Manchester there were 236 men on the job. In four weeks there were 2,500. Stewart had an advertisement in each of the largest provincial papers, saying that carpenters and bricklayers were wanted, and they came in from all over the country. As soon as a man came in he was set to work. He got a fair trial, and if he was no good he was discharged. Every morning Stewart and two of his men made a complete tour of the work, and all three took note of how things were progressing. Every gang of men that didn't get ahead fast enough had an American foreman placed behind him. Every day's work was carefully measured and compared with the record of the day before. If there was no improvement the contractor found out why.

Before going any further, it may be well to give a few rather striking figures that tell better than any technical description could, what sort of a job the American contractor had tackled. The plant as it was completed is the biggest in the world

ever built at one time. When Mr. Stewart was asked with what one could compare it, he mentioned the Westinghouse factories at Pittsburg and the General Electric Company's plant at Schenectady. It consists of nine immense buildings, the office building, machine shop, box-factory, power-

force being doubled or quadrupled, they wailed that they could not look after so many men. So they put the men on and Stewart did the "looking." Sometimes they wanted to back out of their contracts, saying that they couldn't buy the material and make any profit; so Stewart went out



THE FIRST AND ONLY SEVEN-MASTED SCHOONER IN THE WORLD.

This steel craft is not only the largest fore-and-after ever built, but it is the largest sailing vessel of any kind in the world. It is 388 feet long at the water line, 50 feet wide and carries 8,000 tons of cargo with a crew of only 16 men. Built in Boston, 1902.

house, steel-foundry, iron-foundry, brass-foundry, pattern-shop, and dipping and drying-shop. The cost of the buildings was about \$7,500,000. Twelve million feet of lumber were used, and 5,000,000 bricks, 750,000 feet of glass, and 40,000 square yards of paving, or enough to pave a street three miles long. About 4,500 men were employed.

Putting up this building was a fight from the start. No sooner was one obstacle overcome than another popped up. In the first place, the sub-contractors would not put on enough men. They had ten men on the job where a hundred have been used in America, and when Stewart insisted on the

and bought it for them. When they said they couldn't get some little job finished, he told them that there was \$100 extra in it for them if they did, and somehow the job was done on time. When bulldozing worked best he bulldozed and held their "penalties" over their heads; when they seemed like to stand out he cajoled.

The railway terminus was not far from his works, and the contractor built a line from the depot to the grounds and ran a section of it into every building. Two hundred and fifty carloads of stuff were coming in every day, and Stewart's little engine was kept breathless, shunting it where it belonged, but the supplies were not enough

to keep pace with the work. The fault was the contractors' again. They notified the American that they had shipped goods, whereas the men he sent flying to look them up found the stuff piled up in their yards. He insisted on his advices being sent by telegraph, and, insisted, too, that every shipper supply the car numbers in which the stuff was sent, a demand that never before had been made in England. He had his men all over England following the cars. They called on railway superintendents and asked why cars did not get along faster, and kept hammering at the officials until they did something.

In dealing with his men he had first to fight their prejudice against him because he was a "damned Yankee." The more they saw of him, though, the better they liked him. He made a policy of keeping every promise he made them. If he said he would pay a man extra for a job, the man got his pay. If he threatened to "fire" a man if he didn't do better, the man was fired. He paid his men two cents an hour above the union wages. He allowed them "walking time"—half an hour in the morning to get to the works. He kept a supply of hot water to be served out to them for their tea. When they did a job especially well, he treated them all to free beer. The union rules of England did not allow him to pay the men that did the most of the work the best wages, but he got around that by keeping only the best men and discharging the rest.

And he made them work as they had never dreamed of working before, and as none of the men who had been blaming the British laborer for the decadence of British trade had ever dreamed they could work. One reason was that Stewart is a practical

man himself. He studied under his father, who was an architect, and then went out and worked at other trades. He can lay a brick and can cut stone and do carpentering, as the men have discovered.

The way in which he shook up the brick-laying part of the job is a fair specimen of the things he did to the men's long accustomed ways. When the work first began, bricks were being laid as they are laid everywhere in England, at a rate of about 400 a day. There were no steam "hoists" for sending the brick up to the scaffolding, and the men were using stiff mortar. Under the new regime automatic "hoists" were set to work in a jiffy, and soft mortar was supplied to the men.

Stewart explained to the men personally how, by using the American mortar, they could lay enough with one stretch of the trowel for six or a dozen bricks, and lay the bricks themselves by a light pressure of the hand and a light tap with the trowel, instead of by repeated hammering to force the brick into the stiff mortar. He told them to their horror and amazement that bricklayers in America laid 2,000 bricks a day and thought nothing of it. He had hardly got the words out of his mouth, however, when one of the men contradicted him bluntly. He said he had been in America and he knew how bricks were laid there. Stewart, looking, as usual, as if he had just come out of a men's furnishing shop, with glossy derby, natty business suit, and patent leather shoes, was standing on the ground and talking to the men on the scaffolding above. He jumped for the ladder leaning against the building, and in four steps was standing on the scaffolding beside the man who had contradicted him. He rolled up his sleeves, and, filling a trowel

with mortar, he laid four complete rows of bricks with a deftness and dispatch that made the men's eyes stick out of their heads. Then he went on, but left an overseer behind him to see that the men worked faster and faster. Little by little he got them along, until, finally, they, too, could and did lay 2,000 a day. Yet the London County Council, the governing body of the metropolis, reported recently that the average of bricklayers on municipal works was "over" 330 a day.

The "boss" got just as striking results with the other men as with bricklayers. When he arrived the carpenters were aver-

aging 500 feet of timber a day, and they finally averaged 1,000. The steel workers were doing their riveting by hand, and the union tried to make trouble; Stewart insisted that automatic riveters be used. In the beginning the men disposed of from ten to fifteen tons of steel a day; they learned to use up 100 tons. Their first rate of riveting was fifty rivets a day; long after it was from 200 to 300.

The work as originally ordered was done in ten months from the time the American "hustler" took hold, but the company made certain changes in the plans and extended the undertaking so that several months'



NEW YORK DOCKS.

Ocean Freight Vessels that carry our goods to foreign ports.

additional work were required. Mr. Stewart had an experience which, while financially profitable and a valuable lesson to his English rivals, was trying to his own powers of endurance. Various liberal offers were made to him by important London institutions, urging him to stay and continue similar work in their behalf, but he declared that it was too big an under-

taking for one man to revolutionize a whole country. "Mr. Westinghouse made it a big object for me to come over here," he said, "and I am going back from \$30,000 to \$40,000 better off than when I came, but I said to him when the work was done, 'you have had the best five years of my life, but you have had that all in one.'"



EAST RIVER DOCKS, NEW YORK.—Vessels from foreign ports unloading cargo.

OCEAN TRAFFIC—ITS STUPENDOUS GROWTH

In no branch of industry has progress been more noteworthy than in the construction of the ships that sail the seas. Between the hollow log on which the first savage mariner floated across a lonesome river, and the caravels with which Columbus sailed to discover a new world, the difference was not greater than between those little Spanish vessels and the ocean greyhounds which now speed back and forth, like shuttles weaving the threads of commerce together over all the world. Even the Great Eastern, which for more than forty years held the record as the largest vessel that had ever floated, is now surpassed by Atlantic liners in regular service. And that famous old craft was chiefly distinguished for its size, proving unprofitably slow and inadequately engined.

Greatness is a relative term, and sometimes one vessel excels others in one measurement, while itself excelled in another. Length, breadth, depth, carrying capacity

and other qualifications enter into the tests of merit, and the accompanying table will serve to indicate these details for the most famous of recent Atlantic liners:

Ship—	Date	Length all, feet.	Beam, feet.	Depth, feet.	Displacement, tons.	Gross tonnage.	Speed, knots,
Great Eastern	1858	692	83	57½	27,000	18,915	14½
Paris	1888	560	63	42	15,000	10,500	20
Teutonic	1890	585	57½	42	13,800	9,984	20
St. Paul	1895	554	63	42	16,000	11,600	21
Lucania	1893	625	65	41½	19,000	12,950	22
Kaiser Wilhelm ..	1897	649	66	43	21,000	14,349	22.8
Oceanic	1899	705	68	49	32,500	17,274	21
Deutschland	1900	686	67	40 1-3	23,500	15,500	23.5
Celtic	1901	700	75	49	37,700	20,880	16

It will be seen that there is a gradual steady increase in the size of such craft, except that the Celtic, greatest of all, is slower than some of its immediate predecessors. This seems to suggest a tendency toward slower boats once more, on account of the very great expense of driving such enormous bodies through water at the highest rate of speed. The additional space required for coal, deducted from cargo



THE CAMPANIA, A PASSENGER GREYHOUND OF THE ATLANTIC.

(Length, 625 feet; breadth, 65 feet; displacement, 19,000 tons; speed, 22 knots, or 25 statute miles, an hour; capacity, about 2,200 passengers.)

capacity, the cost of the great increase in coal consumption, and the great additional engine power required for adding every mile above sixteen knots an hour, go far to destroy the profits on a great steamer, and except when compelled by the force of competition, owners prefer a slower schedule for the voyage.

A dozen or more important transatlantic lines maintain regular passenger service between the ports of the United States and Europe. Here are some figures which indicate the magnitude of the provision that must be made for the sustenance of passengers and crew during the voyages. They refer to a vessel which is by no means the largest nor the newest of the ocean greyhounds, but they are no less significant. The same facts would take even more striking form if they were applied to such vessels as the *Deutschland* or the *Oceanic*.

For a single passage to America the *Etruria*, with 547 cabin passengers, and a crew of 287 persons on board, carries the following quantities of provisions: 12,550 pounds fresh beef, 760 pounds corned beef, 5,320 pounds mutton, 850 pounds lamb, 350 pounds veal, 350 pounds pork, 2,000 pounds fresh fish, 600 fowls, 300 chickens, 100 ducks, 50 geese, 80 turkeys, 200 brace of grouse, 15 tons potatoes, 30 hampers of vegetables, 220 quarts of ice cream, 1,000 quarts of milk, and 11,500 eggs (or at the rate of one egg per minute from the time the ship sails from Liverpool until her arrival in New York).

The quantities of wines, spirits, beer, etc., put on board for consumption on the round voyage comprise 1,100 bottles champagne, 850 bottles claret, 6,000 bottles ale, 2,500 bottles porter, 4,500 bottles mineral waters, 650 bottles various spirits.

Crockery is broken very extensively, being at the rate of 900 plates, 280 cups, 438 saucers, 1,213 tumblers, 200 wine-glasses, 27 decanters, and 63 water-bottles in a single voyage.

As regards the consumption on board the whole Cunard fleet for a single year, the figures seem almost fabulous—4,656 sheep, 1,800 lambs, 2,474 oxen are consumed—an array of flocks and herds surpassing in extent the possessions of many a pastoral patriarch of ancient times—besides 24,075 fowls, 4,230 ducks, 2,200 turkeys, 2,200 geese, 53 tons of ham, 20 tons bacon, 15 tons cheese, and 831,603 eggs.

Other articles are in extensive demand, and in the course of a year there is consumed one ton-and-a-half of mustard, one ton and three-quarters of pepper, 7,216 bottles of pickles, 800 tins sardines, 33 tons salt cod and ling, 4,192 four-pound jars of jam, 15 tons marmalade, 22 tons raisins, currants and figs, 18 tons split peas, 15 tons barley, 17 tons rice, 34 tons oatmeal, 460 tons flour, 23 tons biscuits, 33 tons salt, 48,902 loaves of bread of 8 pounds each.

The Cunard passengers annually drink and smoke to the following extent—8,030 bottles and 17,613 half-bottles of champagne, 13,941 bottles and 7,310 half-bottles claret, 9,200 bottles other wines, 489,344 bottles ale and porter, 174,921 bottles mineral waters and 344,000 bottles spirits; and 34,360 pounds tobacco, 63,340 cigars, and 56,875 cigarettes.

The heaviest item in the annual consumption of the company is of course coal, of which 356,764 tons are burnt, nearly equal to 1,000 tons for every day in the year.

With regard to the aggregate employment of labor by the Cunard Company, it

includes 34 captains, 146 officers, 628 engineers, boiler-makers and carpenters, 665 seamen, 916 firemen, 900 stewards, 62 stewardesses, 42 women to keep the upholstery and linen in order, with 1,100 men of a shore gang, or about 4,506 people to run the ships, which traverse yearly a distance equal to five times that between the earth and the moon!

shipyards build our men-of-war and the passenger liners of American companies. At San Francisco, for instance, was built the Oregon, which became the most conspicuous battleship in the world by virtue of its wonderful voyage from Puget Sound to the Caribbean Sea by way of Cape Horn and thence to the Philippine Islands, during the Spanish-American war. On the



SHIPWRECK ON THE OCEAN.

Terrible storms and collisions in fogs sometimes cause frightful disasters and the loss of many lives.

Great Britain, France, Germany and the United States are the homes of the great shipyards of the world. Russia, Austria, Italy and Japan, it is true, have their shipyards where the smaller vessels for their own service are built, and even in some instances great battleships. But generally speaking, even they and most other nations come to the countries first named for most of their more important naval constructions. In the United States, several great

Atlantic coast Philadelphia, New London and Newport News are known as the location of the most important American shipyards. Here great battleships are constructed, not only for our own navy, but for the navies of Japan, Russia and other countries. Here, too, have been built many of the largest and finest ships that cross the Atlantic and the Pacific Oceans in passenger traffic. The New England shipyards still build many of the sailing vessels, in

which Yankee sailors have carried the American flag to every quarter of the world, and of late years there appears to be a revival of the popularity of sails, in spite of the great increase in the steamship fleets.

As the world tends to become smaller, with the extension of international trade and friendship, it becomes more important and more profitable to develop the shipping industries upon these highways which nature has provided free to all. There was a time when the Yankee skipper, the Yankee sailor and the Yankee ship stood at the head of the list, with a just share in the world's commerce. In later years this

condition changed, and the American flag has not been so well known in the ports of the world as it was from 1830 to 1860. Again the pendulum is swinging in the other direction, and we have the prospect that in a few years Americans will once more begin to control their share of ocean commerce. The same men whose genius in organization unites railways, banks, steel mills, packing houses and the other great industrial and commercial enterprises, into powerful syndicates making themselves felt the world over, have turned their attention to this department of business activity, and the results are bound to be seen.



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THE GREAT PHILADELPHIA SHIP YARDS.

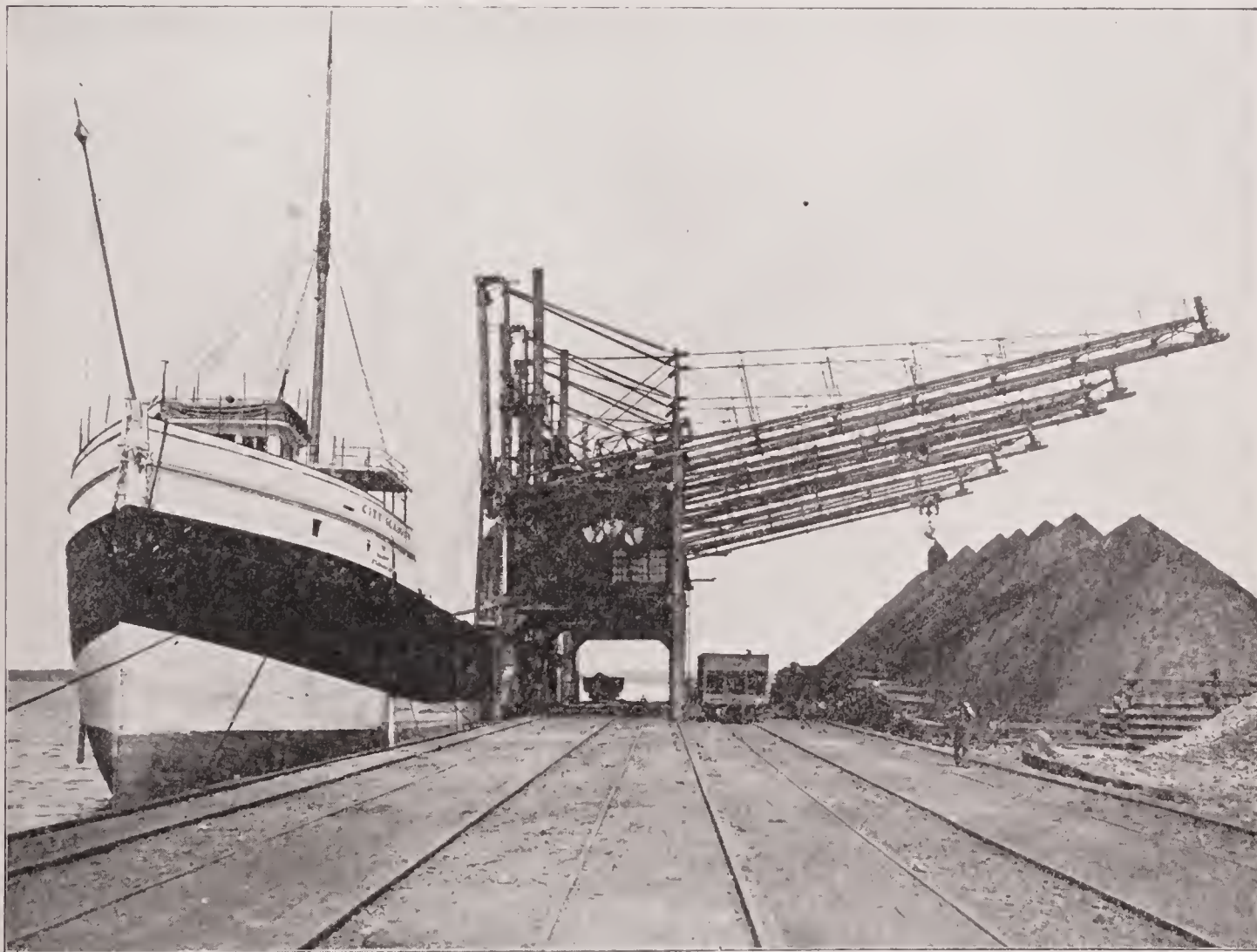
Showing an Ocean Liner in the dry dock for repairs.

SHIPPING ON THE GREAT LAKES

From the Atlantic Ocean to the very heart of the American continent, by way of the St. Lawrence River and the Great Lakes, there is a commercial route over which traffic passes throughout the eight months of open navigation every year, so immense in its magnitude that it never fails to astonish those who consider it for the first time. From Niagara Falls to the sea this route is virtually uninterrupted for more than 1,000 miles, except by the short canals which are necessary to pass around the rapids of the St. Lawrence. Niagara Falls, however is an obstacle difficult to

surmount, and although the Welland Canal, connecting Lake Erie and Lake Ontario, makes it possible for vessels to continue their journey, yet in practice not a great deal of the trade is carried through uninterruptedly.

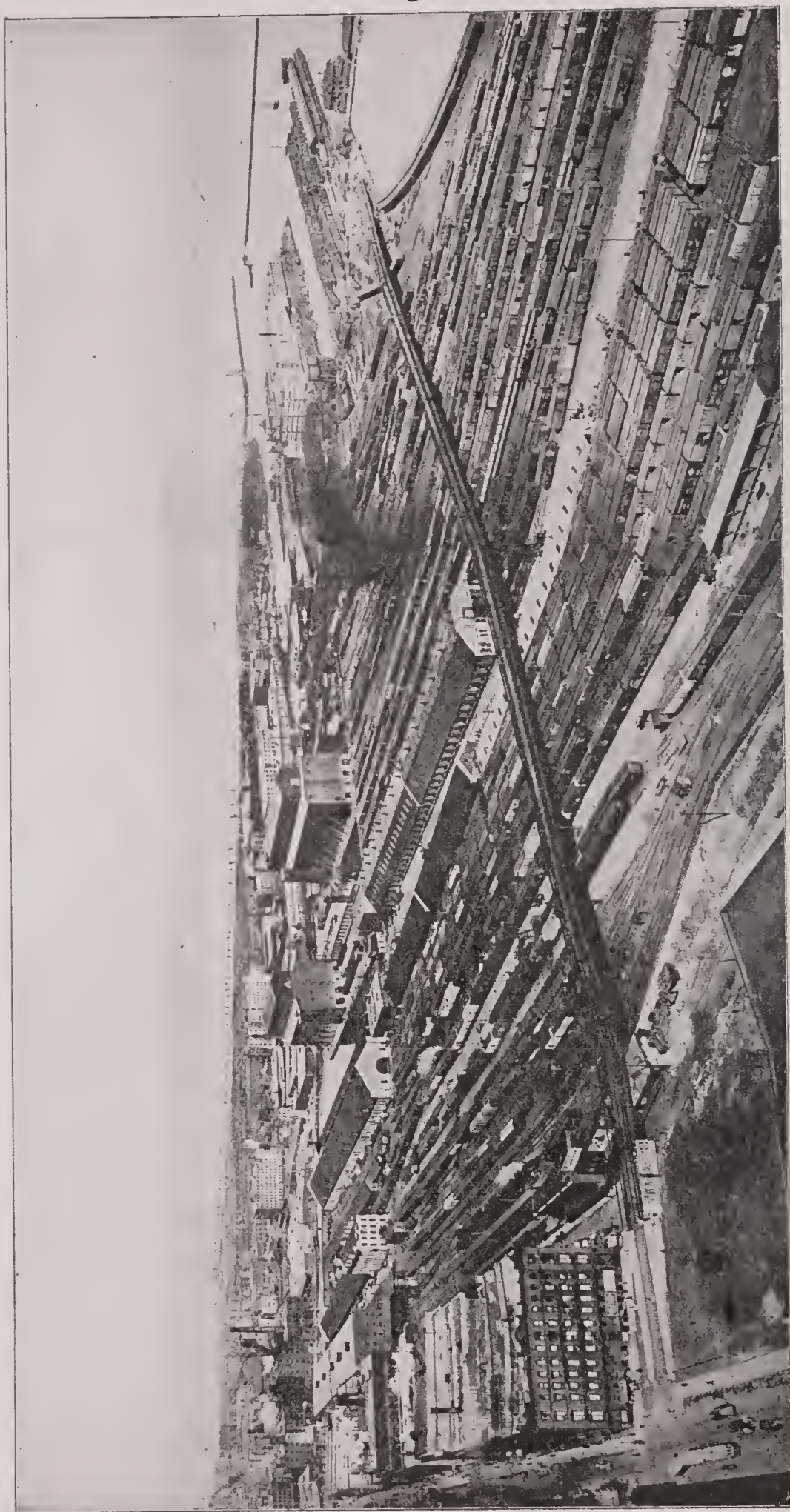
From Buffalo to Duluth at the head of Lake Superior, and Chicago at the head of Lake Michigan, however, the travel routes are unbroken. Indeed there is no interruption in direct navigation among all the ports of the upper lakes, except that at Sault Ste. Marie the United States Government has built a great canal lock, the



IRON ORE DOCKS ON LAKE ERIE.

largest in the world, by the aid of which vessels overcome the twenty-one-foot difference in level between Lake Superior and its lower neighbors.

By way of Lake Superior, Lake Michigan and Lake Huron come the immense shipments of agricultural and lumber products from the numerous ports around their shores. From the Lake Superior region come the huge cargoes of iron ore and copper from northern Michigan, Wisconsin and Minnesota. Duluth and West Superior, at the head of this greatest lake,



ENTRANCE TO CHICAGO RIVER FROM LAKE MICHIGAN.

This is a bird's-eye view of the city freight yards of the Illinois Central Rail way at Chicago. The tract thus occupied lies at the mouth of the Chicago river, and the docks and elevators are convenient for an exchange of freight with the railway. Michigan avenue is the street at the extreme left, and in the distance appears the boulevard leading north along the lake shore to Lincoln Park.



IRON MINE IN THE LAKE SUPERIOR REGION.

also ship immense quantities of grain from the wheat fields of the northwest. It was at the shipyards of West Superior that those peculiar craft, the "whalebacks," known to all lake men as the "pigs," were built, and in them are carried millions of tons of grain, ore and coal every season. There is no trouble in finding return cargoes for vessels on the Great Lakes, whichever way they sail. The great wheat, lumber and ore carriers from Lake Michigan and Lake Superior discharge their cargoes at Detroit, Cleveland, Erie or Buffalo, and return laden with coal or manufactured products, so that there is a constant exchange between east and west, with profit to all interests concerned.

Few people realize that the traffic on the great lakes of North America is one of the largest industrial enterprises in the world. The commerce of such a port as Chicago is as great as that of New York. The volume of traffic passing up and down through the great canal connecting Lake Superior and Lake Huron at Sault Ste. Marie, is greater than that passing through the Suez Canal, and the traffic passing the city of Detroit on the Detroit River is much greater than the ocean traffic at the port of New York City.

For a few months in the winter all this navigation system is closed by ice, and traffic is halted until the ice breaks up in the spring. It is evident, therefore, that

the date of opening navigation is of great importance to the immense interests involved. So regular is the season, that steamship owners are able to calculate in advance about what time the first vessels may pass through the narrow channels connecting the different lakes. But sometimes all rules fail. In the spring of 1901 navigation was closed by ice later in the season than it had been for fifty-seven years, or virtually since the trade of the lakes grew to important proportions. The April ice jams forbade communication between the upper and lower lakes until well into the month of May, a whole month later than the average date of opening. Of course, every day's delay meant great loss to vessel owners and those who were dependent upon shipments by water, and the total loss in this month of delay reached an enormous figure.

There are three places that are watched for the signs of opening navigation. These are, respectively; the St. Mary River, which connects Lake Huron with Lake Superior; the Straits of Mackinac, connecting Lake Michigan and Lake Huron, and the St. Clair River, connecting Lake Huron with Lake St. Clair, just above Detroit. The last of these being the farthest south, is usually the first to open, and when vessels find a channel through the straits of Mackinac, that is usually considered as a signal that navigation from the upper to the lower lakes is once more free. In 1901, however, although the Straits and the "Soo" were open to free navigation almost as early as usual, it was not possible to go from Lake Huron into the lower lakes. A succession of northeast winds carried the great ice floes of Lake Huron into the southern extremity of the lake, where they packed and

jammed instead of melting and scattering in open waters, as they would have done under other circumstances. The current of the lakes flowing into the St. Clair River at this point aided the winds in blocking up the narrow channel, and the result was that a solid mass of ice accumulated at the foot of Lake Huron, perhaps fifteen by twenty-five miles. The jam extended into the St. Clair River, which is about thirty miles long, and for weeks that stream was packed solidly with the great cakes of ice.

All the vessels which had sailed from ports on Lake Michigan and Lake Superior were blocked by ice jams above, and all those from the lower lakes were held at Detroit, unable to go farther up stream. It was not until April 29 that one boat got through to Detroit from the upper lakes, and two days later fourteen came through. After that the jam packed solidly again, and it did not finally open until the 8th of May. In the St. Clair River itself, and in the narrow canal which extends from the mouth of the river into deep water in Lake St. Clair, the ice cakes had actually filled the stream from top to bottom until a great dam was formed. Above the jam the water rose, but below fell so far that in Lake St. Clair and the Detroit River navigation was greatly embarrassed by the shallow water.

Although the commercial loss by this unfortunate delay was great, the people who lived on the St. Clair River and in Detroit and other neighboring cities had some recompense in the picturesque and interesting conditions that existed. On shore the season was almost summerlike, with flowers, grass and foliage as far advanced as ever in early May. Excursionists by the hundreds came out on the electric cars that

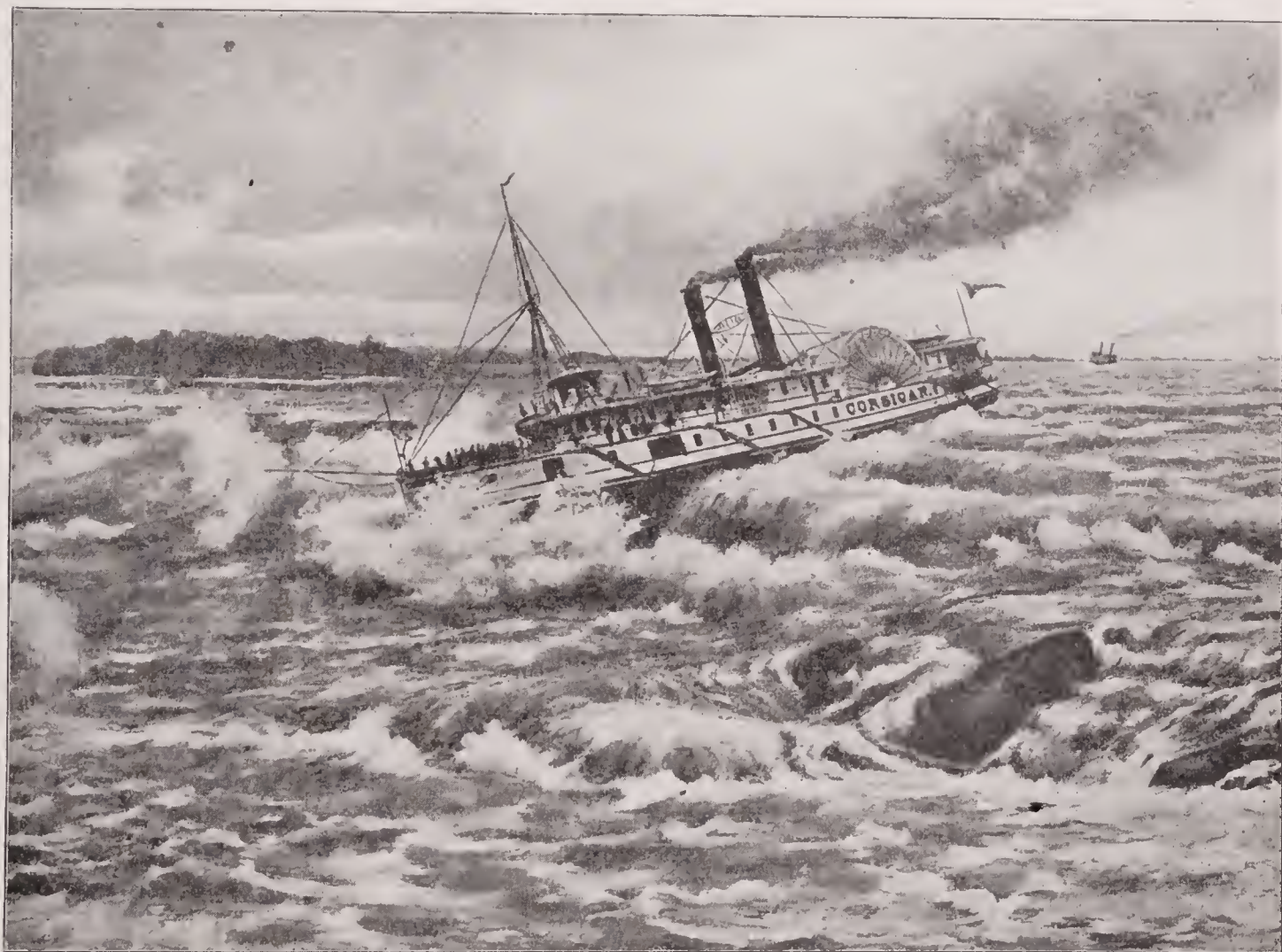
run along the river bank, wearing their summer suits and straw hats, to see the marvelous masses of ice that were blockading the commerce of the lakes. Scores of great vessels were held captive for from one to four weeks, some of them above or below the ice jams, and others in the very midst. The latter experienced all the sensations of Arctic exploration, cut off from shore as they were, except when they sent men to make perilous trips back and forth over the ice for provisions.

When the jams finally began to break, and the glacier-like masses began to race down stream again, the vessels held in their clutch were at times in great danger. Docks along the shore were torn to pieces, vessels were dragged from their moorings and in

some instances badly damaged, and others were left aground. Altogether the conditions were memorable, and those who had occasion to deal with the lake traffic at that time earnestly hope that nature may play no more such tricks upon them.

AREA OF THE GREAT LAKES OF THE UNITED STATES.

	Su- perior.	Mich- igan.	Huron.	Erie.	Ontario.
Greatest length in miles	390	345	270	250	190
Greatest breadth in miles	160	84	105	60	52
Greatest depth in feet	900	1,800	1,000	204	412
Area in square miles	32,200	22,400	23,000	10,000	6,700
Drainage in square miles	85,000	70,040	74,000	39,680	29,760
Height above sea- level in feet	600	578	574	564	234
Latitude, degrees) 46° 45'	40° 15'	43° 20'	41° 20'	43° 10'	
) 48° 50'	46° 55'	60° 10'	42° 50'	44° 10'	
Longitude, degrees) 84° 30'	84° 40'	80° 10'	78° 35'	76° 20'	
) 92° 15'	87° 08'	84° 30'	83° 10'	79° 50'	
Boundary lines	300	None	220	200	160
United States shore line in miles.....	955	1,320	510	370	230



PASSENGER STEAMER SHOOTING THE LACHINE RAPIDS ON THE ST. LAWRENCE RIVER.



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ALONG THE WATERFRONT, NEW YORK CITY.

THE GREAT INDUSTRIES OF THE SEAS AND LAKES

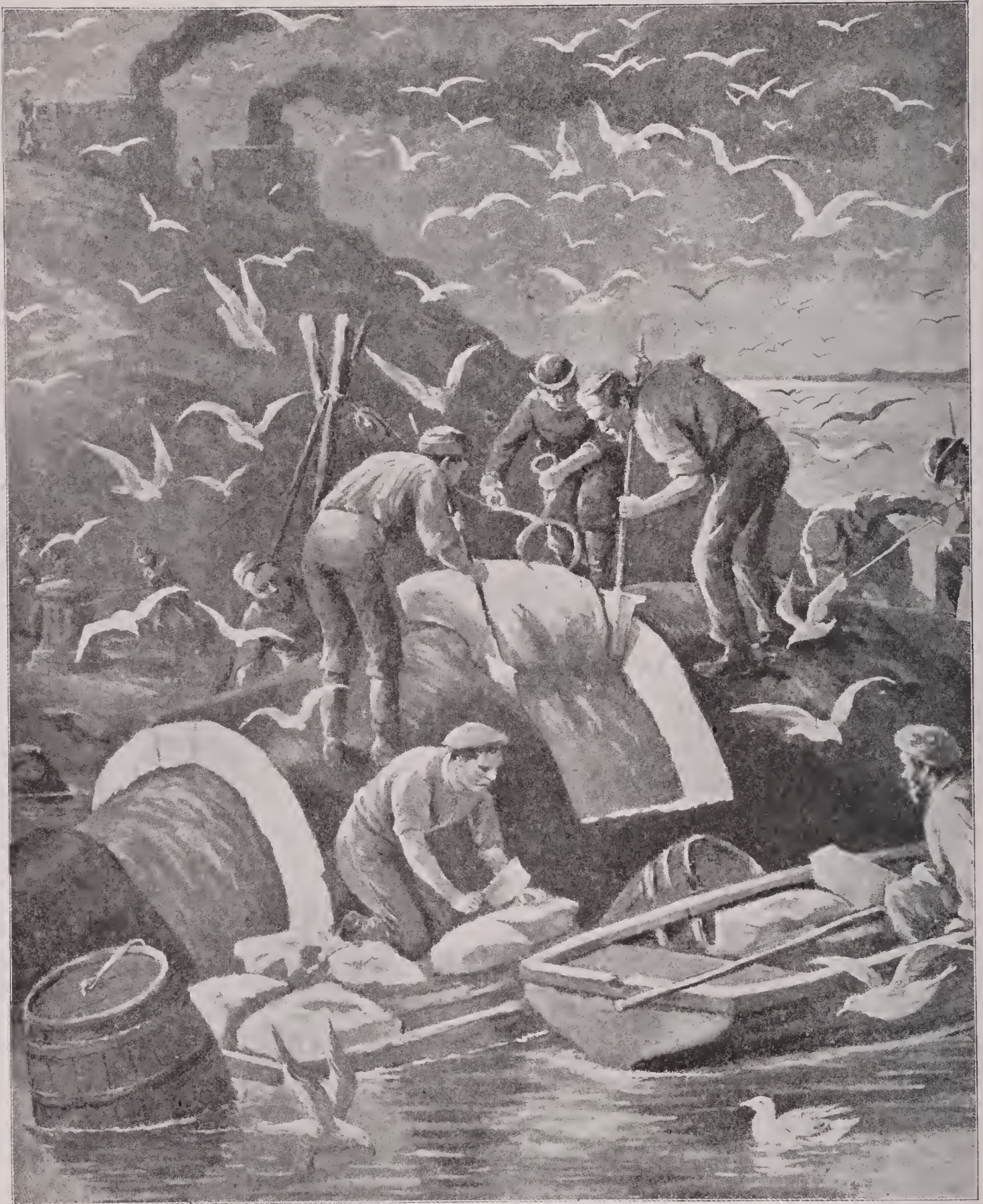
Through all the ages, man has drawn a large share of his sustenance from sea foods, and as the industrial organization of the world has advanced, so the industries which depend upon the products of the ocean grow in size. To-day fishermen in large numbers pursue their vocations in steam craft instead of sail boats; refrigerator cars running on all lines of railway distribute sea food to inland markets in all its delicacy; even the firms and the companies which formerly conducted fishing operations in a small way have begun to form their own corporations, syndicates and trusts, so that in our time all processes of modern commercial energy are enlisted in what was once one of the most primitive of industries.

No longer does the whaler tell dramatic stories of his dangerous pursuit of the monster of the deep, of arms-length charges with the harpoon, of overturned boats, and ferocious assaults by the wounded prey. Instead, steam-powered whaling ships seek the far north, armed with peculiar guns from which they hurl fatal missiles at

long range, with safety to themselves. Whaling indeed is no longer as important an industry as it once was. Various artificial substitutes for whalebone have been invented, while mineral, vegetable and animal oils, ingeniously manipulated, are substituted for most of the former uses of the whale oil. Nevertheless the North Atlantic, the North Pacific, Bering Sea, and the Antarctic regions still support a consider-



FISHMARKET AT GRIMSBY, ENGLAND.



STRIPPING BLUBBER.

Scene at a North Pacific Whaling Station.

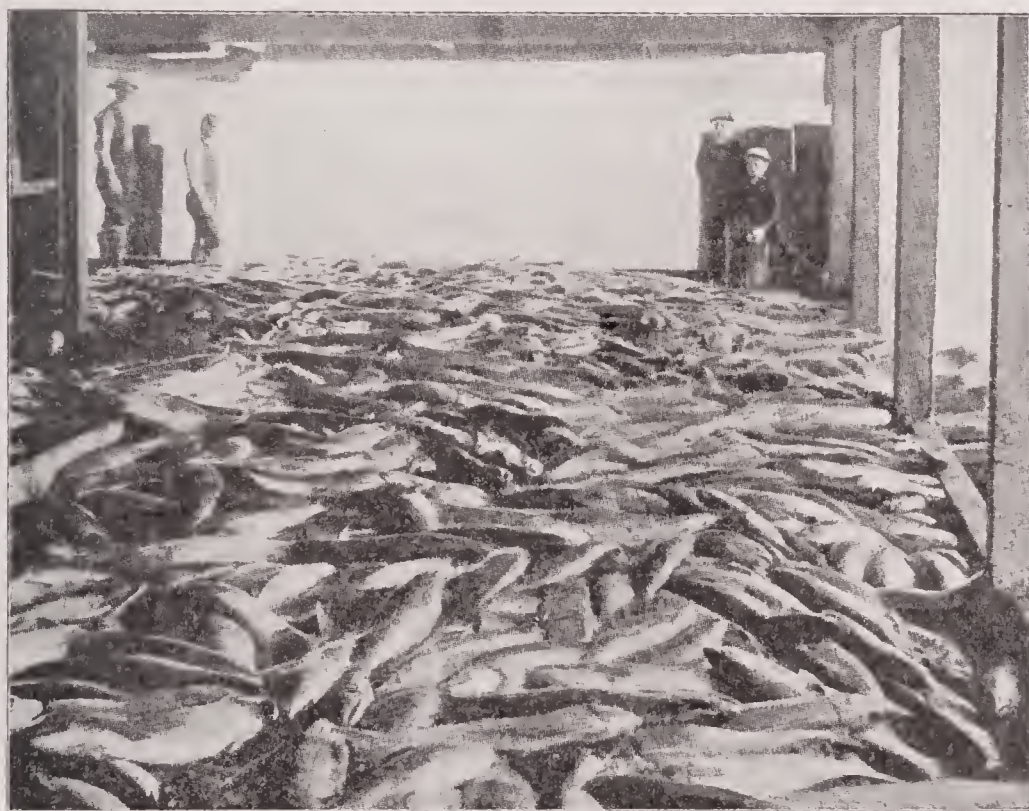
able number of whalers who find the industry a profitable one. Whales have been reduced in number within the last century, by the persistent assaults of the hardy seamen, and it is fortunate that satisfactory substitutes have been found, or virtual extermination would have been their lot.

The most important commercial whale

ber is stripped off for the boiling vats. A special gang of men attends to this part of the work, remaining on shore, and the vessel itself with sailors and whale hunters aboard, returns to the open sea to find more game. Such whale stations are odorous places at best, and their existence is betokened by great flights of gulls attracted

from a long distance by the smell from the boiling vats, and the carcasses upon which the birds live in luxury after all the blubber has been removed.

It is a long distance from the whale fisheries of the Arctic to the sardine fisheries of the Mediterranean, but the taking of the little fish for table use is an industry not second in importance and not less interesting. Multitudes of fishermen around the Mediterranean



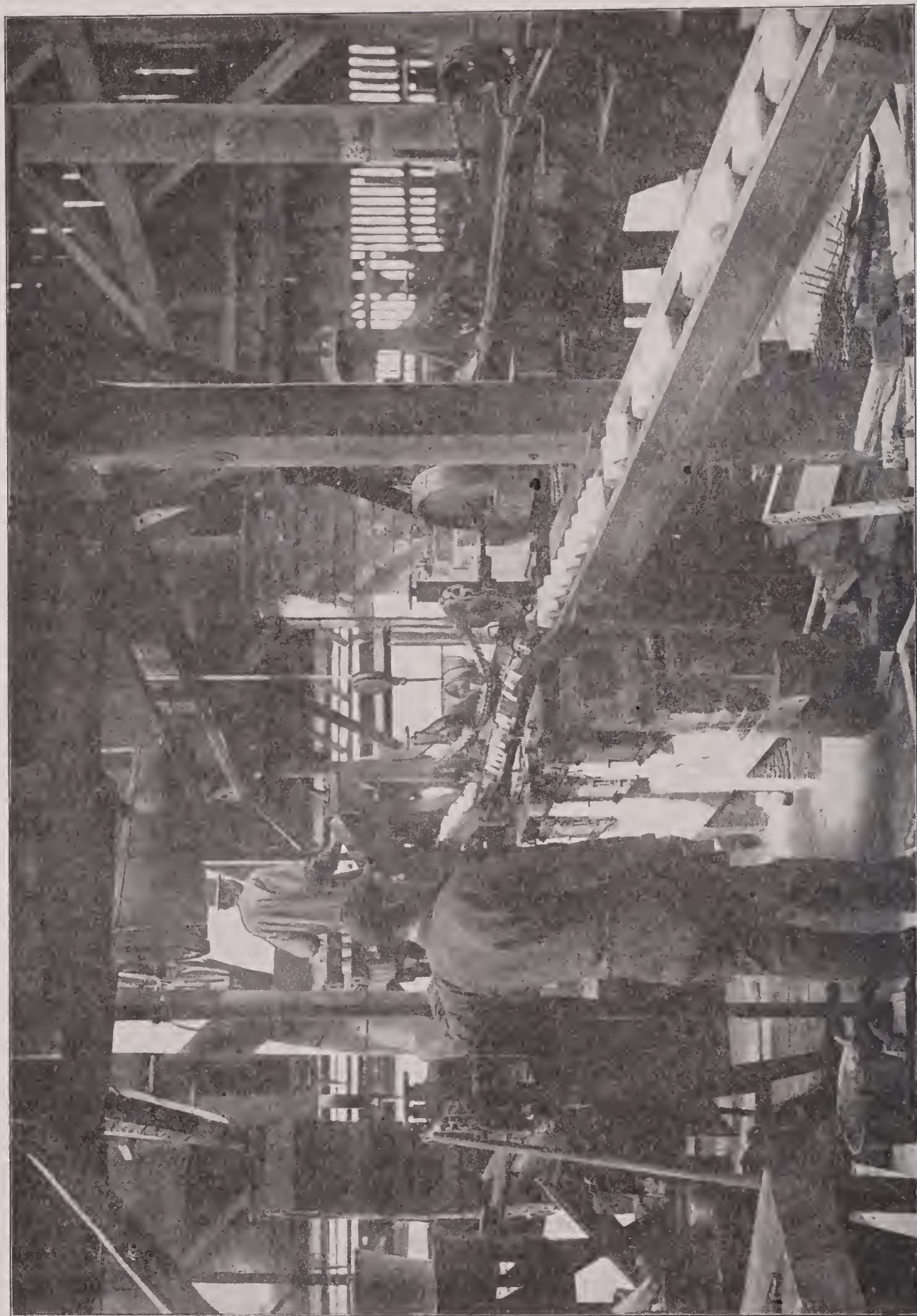
EVENING'S HAUL OF SALMON AT A BRITISH COLUMBIA CANNERY.

fisheries of to-day are in the North Pacific Ocean, Bering Sea and the Arctic Ocean around the Alaskan coast. Every year fleets of whalers spend the winter off Point Barrow, on the north coast of Alaska, in order to be ready for work when the ice breaks up in the spring. On these barren Alaskan coasts, the whale fishers of to-day establish their stations, in order to avoid the necessity of delaying their work on ship-board. These stations are usually situated in some sheltered cove, where great boiling vats are made ready. When a whale is killed it is towed close in shore, and kept afloat by barrels and buoys, while the blub-

ber is stripped off for the boiling vats. A special gang of men attends to this part of the work, remaining on shore, and the vessel itself with sailors and whale hunters aboard, returns to the open sea to find more game. Such whale stations are odorous places at best, and their existence is betokened by great flights of gulls attracted from a long distance by the smell from the boiling vats, and the carcasses upon which the birds live in luxury after all the blubber has been removed.

It is a long distance from the whale fisheries of the Arctic to the sardine fisheries of the Mediterranean, but the taking of the little fish for table use is an industry not second in importance and not less interesting. Multitudes of fishermen around the Mediterranean coasts are busily engaged in the sardine fisheries, which are supplemented for the perfection of the industry by the olive groves along the same coasts, which provide oil for canning purposes. On the Californian coast, too, the sardine and olive oil industries are likewise developing together into commercial importance.

The southern coast of Alaska, British Columbia, Oregon and Washington are the sources of the immense product of salmon which now enters every market either fresh or canned. The salmon fisheries of the Columbia River and the adjacent waters are among the most important of the industries



MAKING TIN CANS BY MACHINERY FOR A GREAT SALMON CANNERY.

of our Pacific northwest. The scene in a great salmon cannery is a striking one, and by the rapidity and deftness of the processes, from the time the great fish is drawn from the water until it appears symmetrically canned and labeled for the market, it suggests no parallel but the packing house in our great stock yards.

On the other side of the continent, over the Grand Banks of Newfoundland, the hardy fishermen of the New England coast drop their nets and their lines for the enormous schools of cod and mackerel. This is one of the most picturesque of all the fisheries of the world, in the novelty of its methods, the bravery of the fishermen themselves and the perils of the work. Storms,

fogs, and swift passenger liners speeding across the Atlantic, unite to threaten disaster to the Banks fishermen, but men rise to the demands upon them, and these very fisheries have bred a race of sailors known wherever ships sail, as unexcelled in courage, reliability and seamanship.

Another phase of the American fisheries is found in the inland waters of the Chesapeake Bay, where the oyster trade employs thousands of men in a pursuit more difficult and dangerous than is generally understood. The lobster industry on the Maine coast is likewise an important one, and rapidly increasing as this food increases in favor with epicures.

Inland fisheries lack some of the charac-



CLEANING FISH IN AN OREGON SALMON CANNERY.



LOBSTER PENS ON THE NORTH ATLANTIC COAST.

teristics of those of the ocean, but they have their own great commercial importance and do not lack picturesque features. From early spring till late autumn, hundreds of hardy men are busily engaged in the Great Lakes, chiefly in Lake Superior, to obtain the enormous quantities of whitefish and trout sold in every city and village.

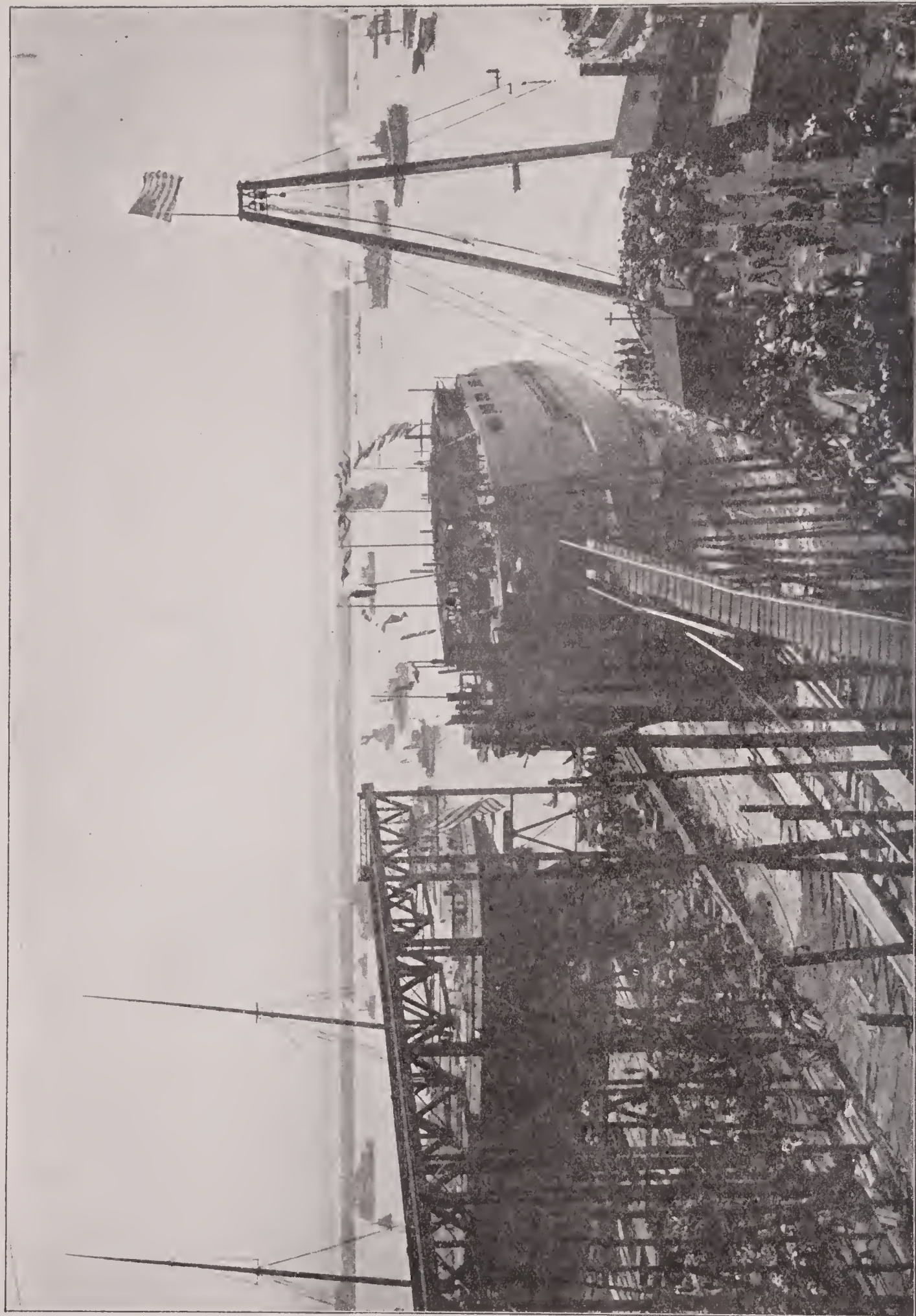
There are river fisheries, too, of great importance, with the Mississippi and Volga as types of this department of the traffic. From the Volga, that greatest river of European Russia, comes most of the caviare which is a favorite delicacy on many tables. The only American supply which rivals it comes from the Lake of the Woods, on the northern boundary of Minne-

sota, where sturgeon fisheries, which produce the caviare, have grown to considerable proportions.

The maritime nations of Europe, which have a crowded population and a large proportionate sea coast, depend more upon sea foods than do we in the United States. Those countries facing the North Sea and the Baltic have developed fishing industries which are growing in magnitude. A large part of the product is consumed locally, but there is also a considerable shipment across the North Sea to the English markets. One of the most important receiving ports is Grimsby, where fishing vessels discharge their cargo for the markets of London and the other large cities.



GRAIN ELEVATOR ON CHICAGO RIVER. CAPACITY, 700,000 BUSHEL.



LAUNCHING OF THE NEW AMERICAN BATTLESHIP, THE MAINE.

Here at Cramp's great shipyards in Philadelphia was built the successor of that unfortunate vessel which was destroyed by an explosion in Havana harbor just before the outbreak of the Spanish-American war of 1898. It is a splendid ship, far greater than its historic predecessor, with 12,500 tons displacement, 16,000-horse power, 20 big guns and a speed of 18 knots an hour.

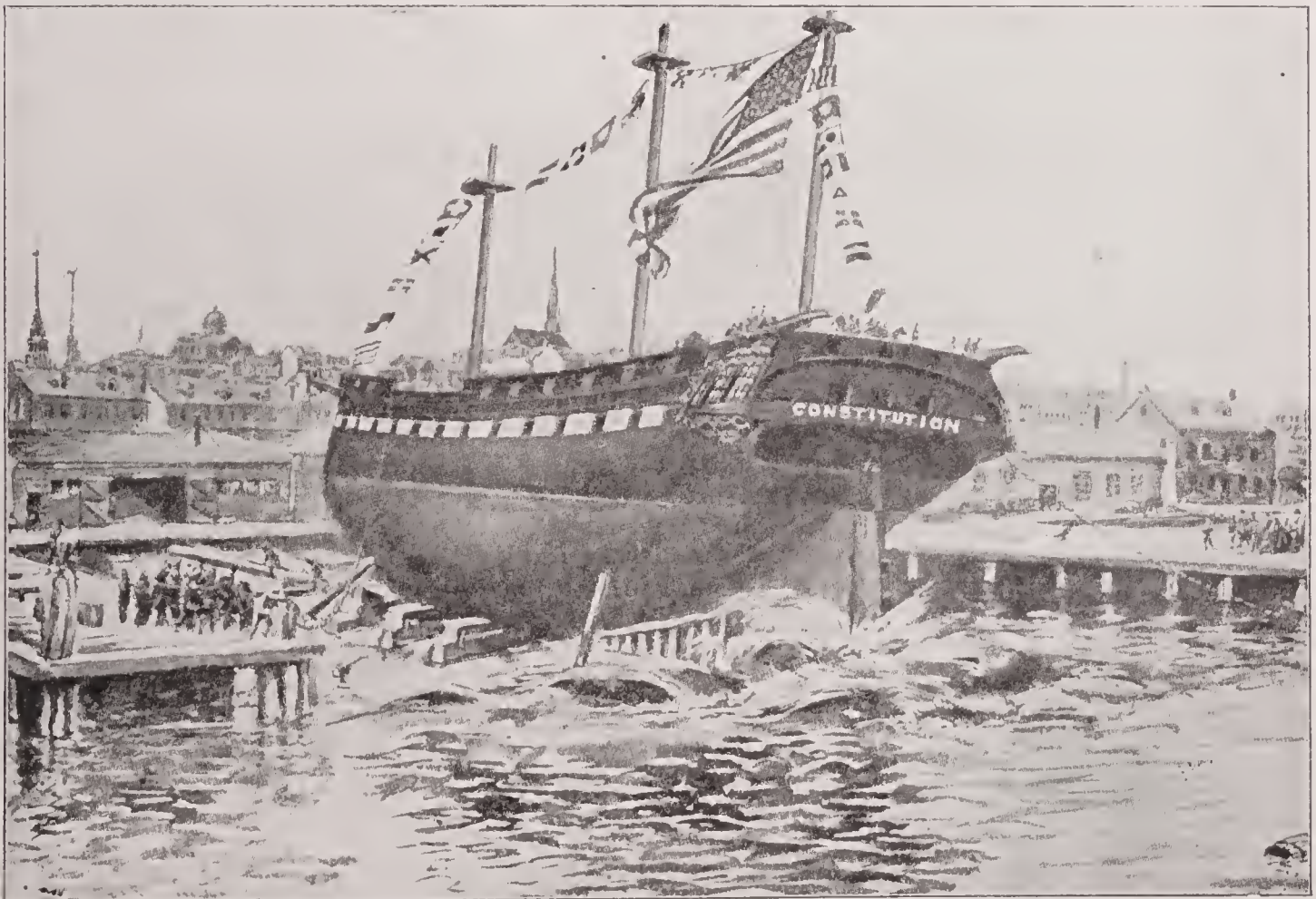
PROGRESS IN METHODS OF NAVAL WARFARE

If it be true that the most certain way to put an end to warfare is to make war more terrible, we should include the Krupps, the Gatlings and the Maxims in the list of our true promoters of peace. Improved artillery, rifles, armor plate and explosives have been devised of late years with a rapidity not second to industrial inventions.

The world's naval wisdom received a surprise and a shock when Ericsson's little iron-sided Monitor fought its duel with the ponderous Merrimac, ribbed with railroad iron. American ingenuity, both north and south, had grappled with the problem of invulnerable warship construction, ignoring absolutely all other naval architects of

the world and their cumbrous lore. Slow-going conservatism had to be abandoned, and the old wooden hulks then constituting the navies of the earth's great powers were doomed to the scrap heap.

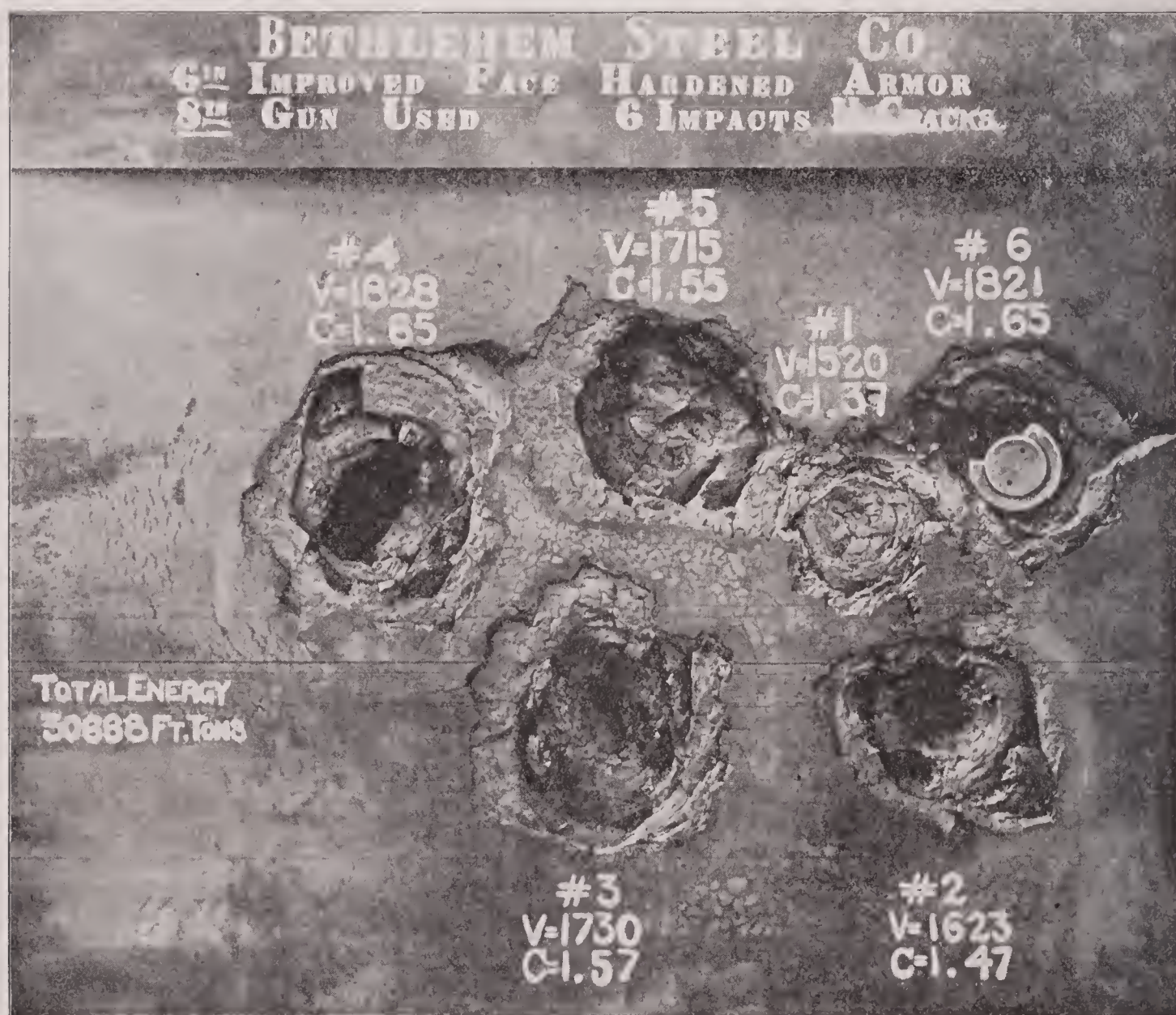
Since that time there has been a constant rivalry between the ship-builder and armorer on the one hand, and the gun, gunpowder and projectile manufacturer on the other hand. Every improvement in armor plate has been met by a further advance, either in the gun, the projectile, or the propelling charge of the gunpowder. An armor-maker would announce the production of a steel plate which no existing cannon could penetrate. Then the projectiles



LAUNCHING OF THE "CONSTITUTION," FAMED IN AMERICAN HISTORY.

were made conical, and with a sharp point, having a fine temper, and the gun was rifled to give the projectile rotation and true flight, and the guns were made to load at the breech instead of the muzzle, adding greatly to the rapidity and facility of fire. Another inventor then came forward with a method of hardening the surface of the plate, by a process bearing his name. A Harveyized plate is so hard that it cannot be scratched with a file or cut with a cold chisel. Nickel was put in the plate, adding still more to its hardness and toughness. Then smokeless powder was produced, de-

veloping much greater energy than its black predecessor, and made to burn with accelerating combustion, and with it projectiles could be hurled with such velocity that the energy of their impact could not be resisted by the plate, and the gun had to be lengthened and strengthened forward to meet the new demands upon it. The limit in the weight of armor plate was soon reached. Twelve inches in thickness came to be about the maximum for the belt of the strongest warship, for she could not carry thicker and float. The projectile was still more improved, being made of the finest forged steel

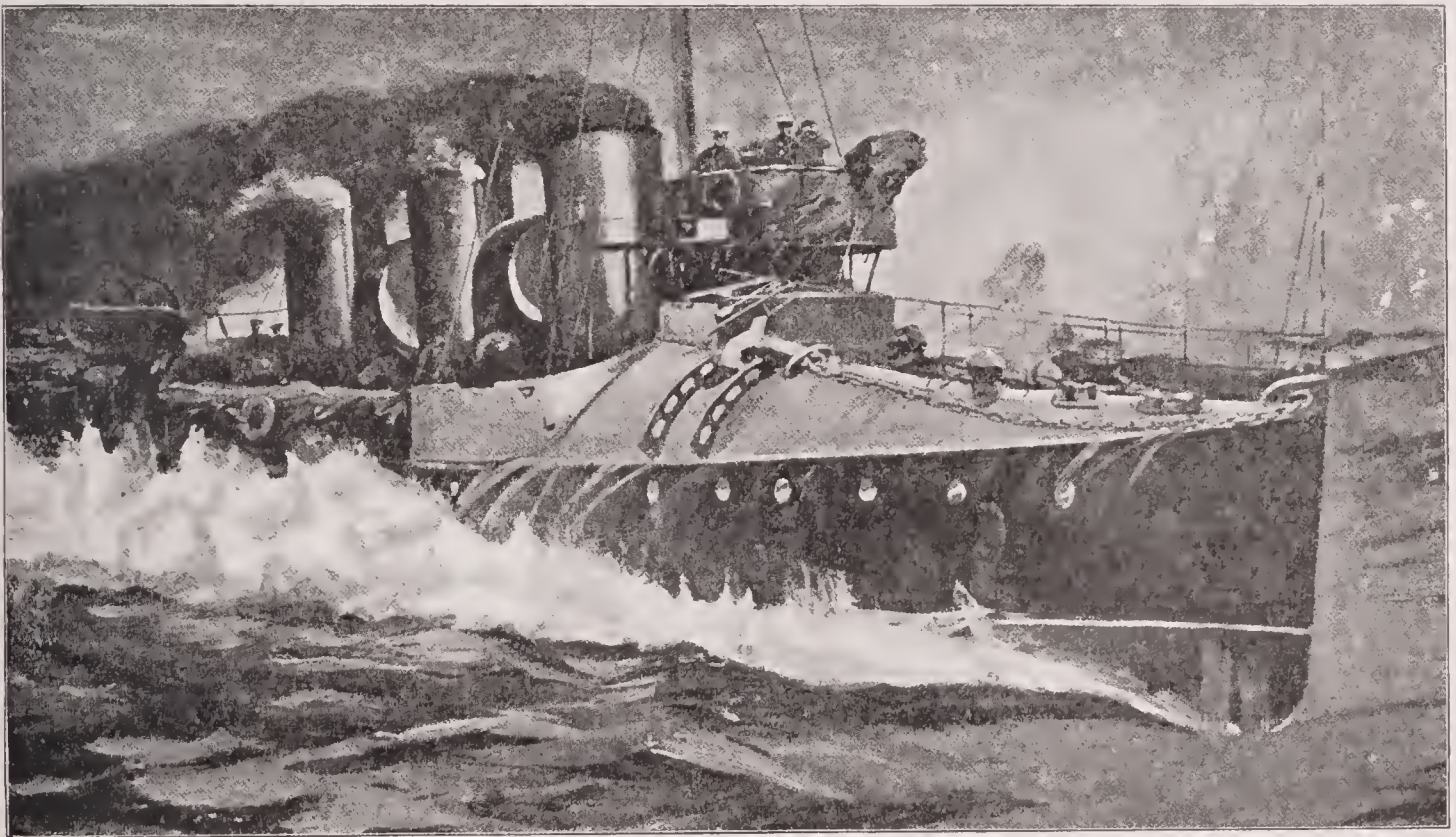


TEST OF ARMOR PLATE FOR AN AMERICAN MAN-OF-WAR.

and tempered with great skill. Then came Kruppized plate, and the projectile was again turned aside or smashed upon its surface. Lastly a soft nose made of mild steel was placed on the point of the armor-piercing projectile, and the gunner could again laugh at the thickest Kruppized plate that could be carried by the battleship.

Contemporaneous with this work, the high-explosive manufacturer and inventor

to learn by experiment. It was believed by many that high explosives must of necessity be very ticklish, and that their sensitiveness must be in direct proportion to their explosive power. The word dynamite was sufficient to cause a person of average information to seek safety in flight from its vicinity. It was generally believed that if high explosives could only be thrown in any considerable quantity from guns they



THE FASTEST SHIP AFLOAT.

The British torpedo-boat destroyer "Viper," steaming at 38 knots, or more than 43 land miles, an hour.

have been busy, but so burdened has been their work by popular misunderstandings of the nature of the high explosives, that they have had a much stronger barrier in the form of prejudice and ignorance to get through than has the gun manufacturer in keeping ahead of the armorer.

There was such a wholesale dread entertained by even rational investigators, and some inventors themselves, of high explosives, that they chose rather to theorize than

would destroy anything they might hit, or if they should strike in the water anywhere near a warship it would be sent to the bottom. But it was thought that guns must be constructed in some peculiar way, and a propelling means especially adapted to lessen the shock be employed for throwing some special kind of bomb, in order to get the dynamite out of the gun very gently.

The most notorious of these freaks in ordnance is the so-called pneumatic dyna-

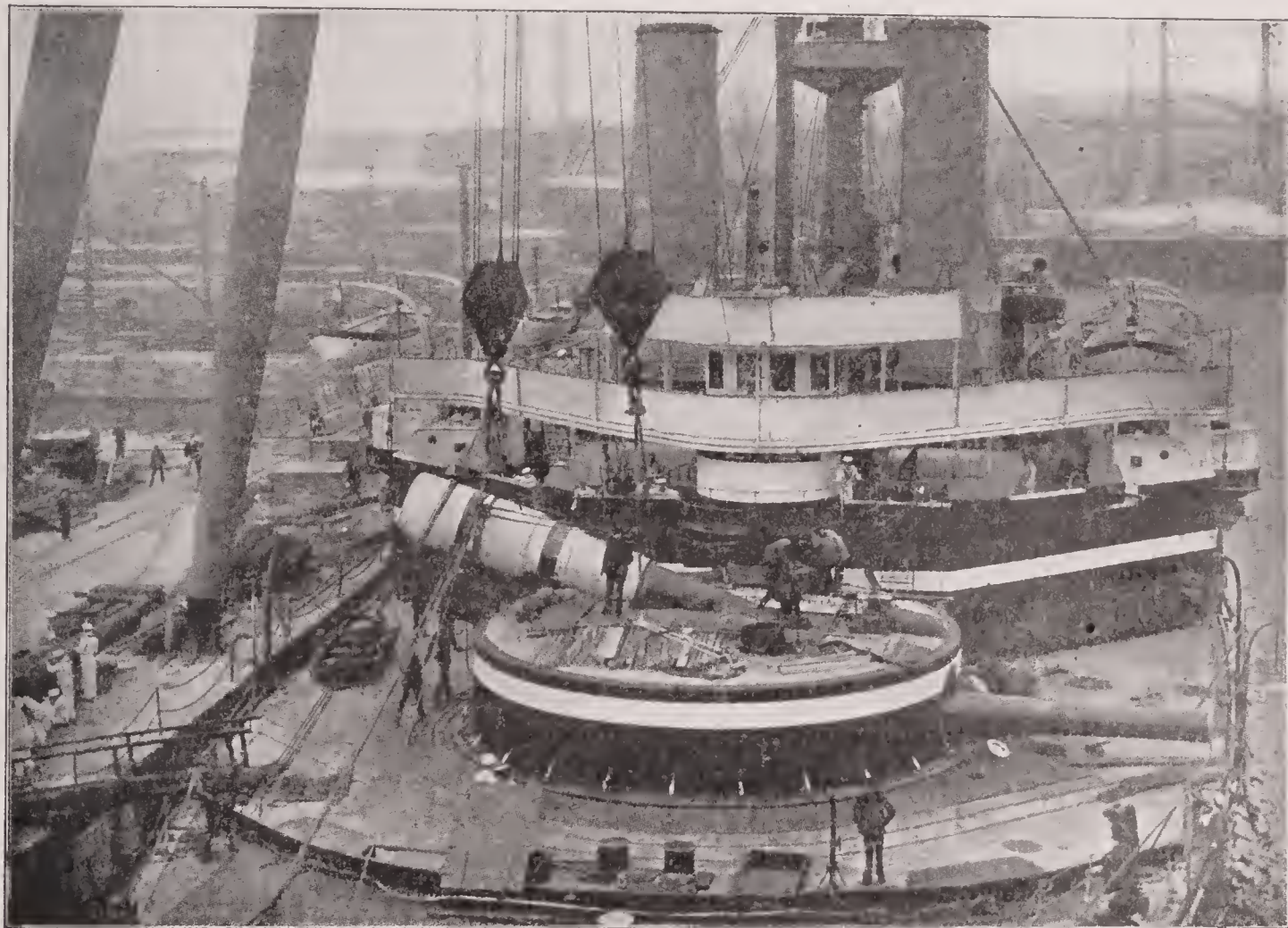


PRACTICAL EXPERIMENTS WITH NEW ARMOR AND PROJECTILES.
Gunnery practice against an obsolete battleship by our North Atlantic Squadron.

mite gun, a battery of which guns was erected at Sandy Hook and protected at great expense, and a similar battery was put up at San Francisco. The expense of these outfits was enormous, and absolutely to no purpose whatever. Their range is limited to about a mile and a half. The projectile has no power of penetration whatever, and

safety within close gunshot of these batteries and bombard them out of existence, and it would be impossible for the pneumatic guns to get a single shot within half a mile of any of the battleships.

In 1899 Gen. A. R. Buffington, the Chief of Ordnance of the United States Army, determined to thoroughly investigate the

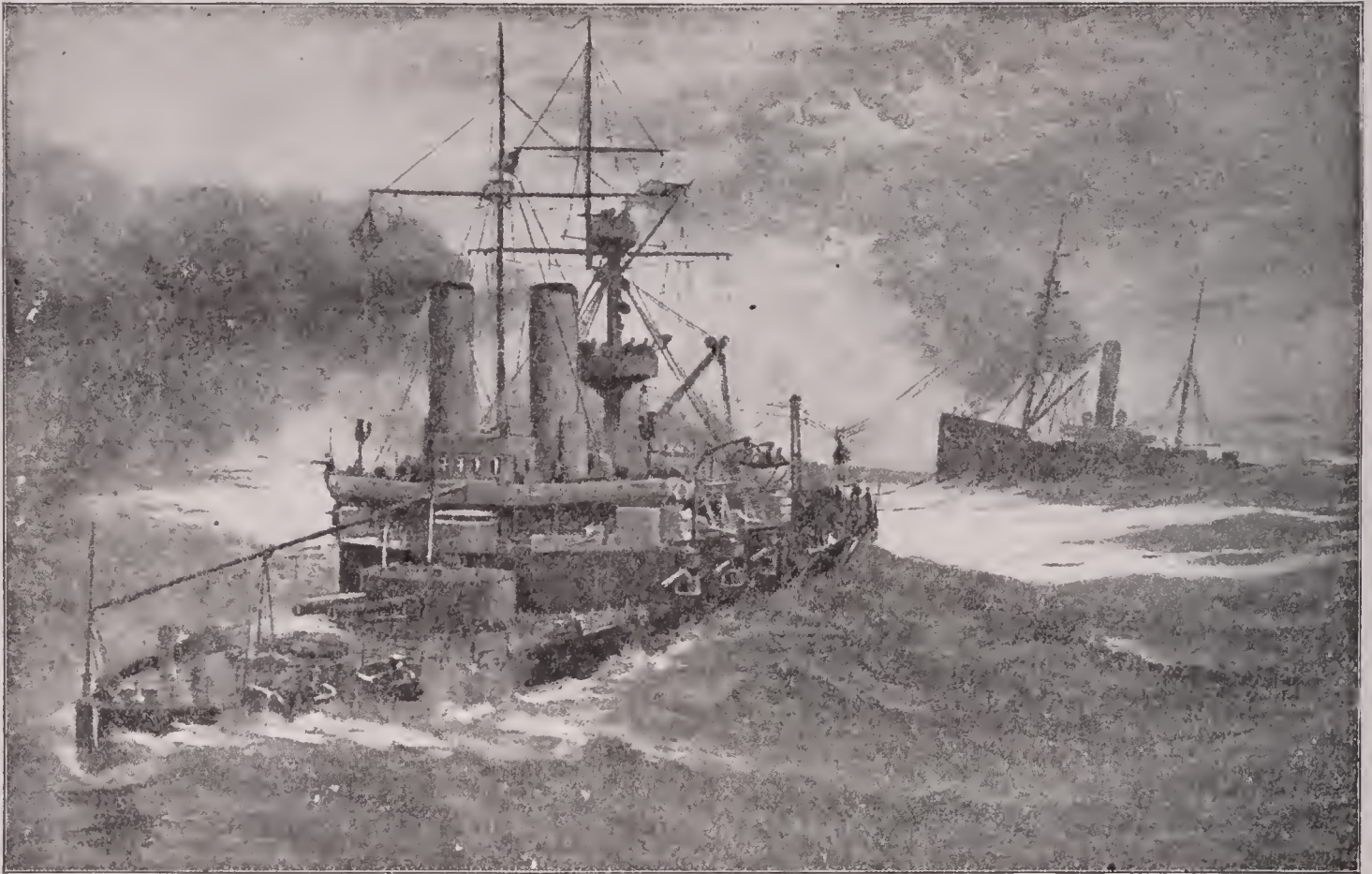


PLACING A BIG GUN ON BOARD A BATTLESHIP.

This extraordinary gun, 36 feet 8 inches long, has a range of 14,000 yards, or eight miles. It fires a shot weighing more than half a ton with a charge of 650 pounds of powder.

must necessarily go off on impact outside of an object, should the gunner be so lucky as to hit anything with it; but the angle of fire is so high, and the range so short, that the question of hitting an enemy's battleship with one of these weapons can be no longer seriously considered. A fleet of modern battleships could lie with perfect

subject of high explosives, and he arranged that the Ordnance Board, with headquarters at Sandy Hook Proving Ground, New Jersey, should carry out a line of experiments in such a thorough and efficient manner as to settle once for all what known high explosives were the most suitable for use in the service, and also to test thoroughly,



COALING A BATTLESHIP AT SEA.

and without partiality, any and all new high explosives which might be submitted by different inventors and manufacturers, provided they appeared to offer sufficient merit to warrant investigation.

MAXIMITE, THE NEW EXPLOSIVE.

Maximite, which was adopted by the Government, satisfactorily stood every test to which it was subjected. It is very inexpensive of manufacture; has a fusion point below the temperature of boiling water; cannot be exploded from ignition, and, indeed, cannot be heated hot enough to explode, for it will boil away like water without exploding. It is, therefore, perfectly safe to melt over an open fire for filling projectiles, in the same manner that asphalt is melted in a street caldron. Should the material by any chance catch on

fire, it would simply burn away like asphalt, without exploding. When cast into shells, it not only solidifies into a dense, hard incomprehensible mass on cooling, but it expands and sets hard upon the walls of the projectile like sulphur, that is to say, in the same way as water does in freezing.

Hiram Maxim, the inventor of this explosive, describes its effects as follows, and adds his opinions on the tendencies of modern warfare: "When a shell filled with it strikes armor-plate, the Maximite does not shift a particle, and it is so insensitive that it not only stands the shock of penetration of the thickest armor-plate which the shell itself can go through, but it will not explode, even if the projectile breaks upon the plate. In one experiment a six-pounder projectile, filled with Maximite, fired against a thick plate, entered the plate about

half its length and upset—that is to say, shortened nearly two inches and burst open at the side, and some of the Maximite was forced through the aperture and the projectile rebounded from the plate about 200 feet and struck in the front of the gun from which it was fired, and all without exploding. Some lyddite shells—that is to say, shells charged with picric acid, the high explosive adopted by the British Government,—filled in the same way as was Maximite, into the same kind of projectiles and fired at a thin plate an inch and a half in thickness, all exploded on impact. So insensitive is this high explosive that melted castiron may be poured upon a mass of it without causing an explosion. The writer has repeatedly made this experiment. When a projectile, however, charged with Maximite, is armed with a proper detonating fuse, such as that used in these experiments, the invention of a United States Army officer, it is exploded with such terrific violence that a 12-inch armor-piercing projectile was broken into at least 10,000 fragments; 7,000 were actually recovered. This armor-piercing projectile, weighing 1,000 pounds, was filled with seventy pounds of Maximite, armed with a fuse, and burned in the sand. After exploding, the sand was sifted to obtain the fragments. There were other high explosives tested with Maximite, which also produced re-

markable results. Had not Maximite been invented, the Ordnance Board would still have in its possession a high explosive developed by the Army Department itself, far superior to anything that has ever been employed in any other country, and the work of that Board for the last two years would



FACTORY FOR HIGH EXPLOSIVES, SHOWING EARTHEN WALLS, TO PROTECT AGAINST DISASTERS.

have still been highly rewarded. Maximite has been adopted for the sole reason that it fulfills the largest number of the highest requirements sought for by the Ordnance Board."

Not since the lesson taught by Ericsson's Monitor has anything been accomplished in military science more pregnant with meaning than these results at Sandy Hook. They have demonstrated that nothing whatever can be made to float with armor which will be capable of withstanding the destructive effects of Maximite shells thrown from modern high-power guns, which are capable of penetrating the thickest Kruppized plates, to explode into a battleship.

Should the United States now become in-

volved in war with any other great power, we should be able to throw these high explosive projectiles through the thickest armor of our enemies, to explode inside their warships, while they, in turn, would be able to penetrate our armor with solid shot, or, at least, with projectiles carrying no bursting charge whatever.

Mr. Maxim also says: "The moral taught by these new developments is that the ponderous battleships must go and be replaced by the small, swift torpedo boat or torpedo gunboat and cruiser, and practically unarmored, as no protection whatever can avail against such missiles. There must be no sacrifice of mobility for cumbersome armor. While Maximite places this government far in the lead of any other power in its weapons of offense and defense, it will, as well, save this government many hundreds of millions of dollars which should otherwise have been expended in the building of unwieldy battleships, for which other powers have squandered fabulous sums, and which must soon be recognized as obsolete. The competition between the great powers for naval and military supremacy is about as keen as it could be in an actual state of war, and the drain upon their resources is enormous, and the burden year by year is growing heavier. It is problematical whether England, France or Germany would prove the stronger in the event of war, and it is equally problematical which can longest endure the ever increasing drain upon its resources as a measure of insurance in the event of hostilities. And there is another problem—and one of vast concern—and it is whether these stupendous preparations are altogether wise on present lines; but no power dares to deviate too far from the main course pursued

by the other powers for fear of making an irreparable mistake, and so big battleship building still goes on, with a sort of half-awakened consciousness that these craft will prove a source of weakness rather than of strength.

"Along with the ponderous, armor-clad battleship, we have seen developed means for its destruction, so that to-day it holds no higher place with respect to invulnerability in face of these means, than did the wooden hulk of a half century ago in the face of the weapons then used. Indeed, it is probable that the modern battleship, costing five or six millions of dollars, will be in still greater danger of being sent to the bottom in a modern naval engagement than was the wooden craft of Nelson's time.

"Let us consider what will be the chief forces that will oppose the battleship and oppose one another in the next great naval engagement. First, there will be the torpedo boat and the torpedo boat destroyer, capable of traveling at a speed double that of the battleship, armed with Whitehead automobile torpedoes, which launched below the water lines will run beneath the surface as straight as an arrow to deal the battleship a fatal blow below its armored protection. There will also be the submarine boat, similarly armed, which has already shown itself capable of stealing upon the battleship wholly unobserved, to deal it a deadly blow, even in the glare of noon, as well as at the dead of night. And there will be another form of torpedo craft, armed with automobile torpedoes, which will run upon the surface of the water like an ordinary torpedo boat, but at railroad speed, and which will dive to a semi-submerged position when coming within the range of the enemy's guns. Half a dozen

torpedoes will be launched by it in a moment, and the little boat will be endangered only by the huge vortexical gulf down which the battleship takes its plunge to the bottom of the sea.

"Now that a high explosive has been developed, which is capable of withstanding

ton or more of high explosive at high velocity, to explode and crush the walls of the battleship or demolish its superstructure, or, if falling in the water, to crush in the sides below the armored belt. Each of these systems will have its advantages over the other, and will also have its dis-



ARMORED BOAT FOR RIVER SERVICE IN CENTRAL AFRICA.

the shock of penetration of the hardest steel wall of the biggest armor-clad, to explode in vital parts, the battleship has another and most formidable antagonist. By means of this invention the destructiveness of the present high-power gun is enormously increased. There will be two systems of guns and projectiles employed—the one the present quick-firing, high-power cannon, throwing armor-piercing projectiles carrying relatively small bursting charges of high explosives, to explode on the interior of the warship, or within the armor, to rip it from the sides. The other will be the torpedo gun, throwing aerial torpedoes carrying half a

advantages. While the large quantity of explosive carried in the aerial torpedo will be capable of working wide destruction when landing fairly on the mark, yet the quick-firing cannon, with equal range, and able to fire many times as fast, with projectiles capable of penetrating the strongest armor, to explode inside, will remain no mean rival to the torpedo gun, and any and all other forms of attack.

NAVAL BATTLES IN THE FUTURE.

"The first and most important lesson which will be learned from the next great naval battle will be that armored protection

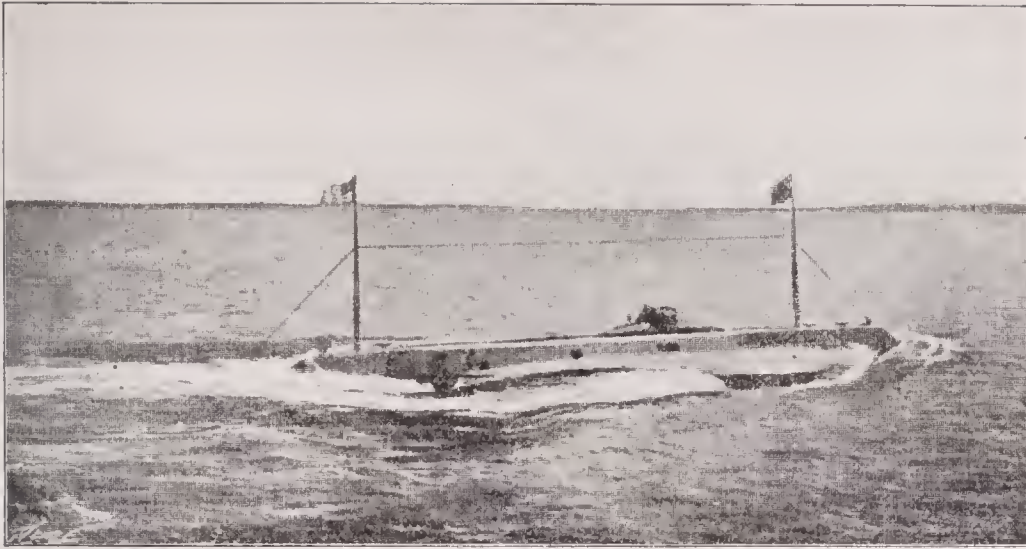
will not protect, and the fight will soon be a duel between battleships at long range, aided by various forms of torpedo boats, and light unarmored cruisers, throwing high explosives; and these latter will be the factors which will determine the fight. The heavy armorclad will be discredited, and then will be a wild scramble by the nations in the endeavor to make up for the lost time wasted on its construction, and light and very swift unprotected war vessels will be constructed, depending for their safety upon their speed, and upon their own ability to strike death-dealing blows. These are the true principles which must, sooner or later, be recognized.

"The British Government now proposes building still larger and heavier battleships and, of course, enormously more expensive. Within the next decade, and sooner, in the event of the great war, this will be learned by the British War Office to be a great mistake. The writer pointed out some years ago that the introduction of gunpowder was long opposed on grounds which, according to twentieth century ideas, are supremely ridiculous. To us moderns nothing could be more apparent than the superiority of firearms over bows and arrows as weapons of war. A few years hence, the present panorama of the nations will appear ludicrous, vying with one another for naval and military supremacy, and exhausting their treasuries in the construction of huge battleships, a dozen of which will be sunk by a torpedo fleet costing no more than one of them. Such battleship destroyers are now an accomplished fact, and lie under the eyes of all the world to-day, but are not seen. Their merits are told into ears that are as deaf as death. It is like knocking at the doors of an empty house for admission.

Only the issue of a great naval battle can bring the torpedo fleet into proper recognition.

"When firearms were first introduced, the foot-soldier was clothed in armor, which was constantly increased in weight and thickness to resist improved weapons, until it became so ponderous and unwieldy as to sadly interfere with mobility. It was found impossible, however, for the soldier to carry armor thick enough to protect him against missiles hurled by gunpowder. As a result, all the armor was discarded. The modern war vessel has now entered upon a similar phase of its evolution, and for exactly the same reason that the soldier was obliged to discard his armor, so will armor have to be sacrificed in the coming war vessel, and the most practical means of defense will then be found to consist in the very means which serve best for offense."

The naval authorities of most of the maritime powers have studied with great interest the progress of experiments in submarine craft. Inventors for years have been endeavoring to perfect vessels that could be submerged and still propelled and controlled with safety to their occupants. This series of investigations has been encouraged by the governments with some spirit of rivalry as to which country should first obtain such a practicable craft. In our own country the vessel known as the *Holland*, named for its inventor, has achieved remarkable success and has been adopted by the government as a worthy adjunct to our coast defense. The vessel travels at fair speed on the surface, may be submerged for several hours without discomfort or danger to its crew, and can travel slowly under water, so that it may advance clandestinely upon an enemy with-



THE "HOLLAND" AT FULL SPEED ON THE SURFACE.

out danger of discovery. For launching torpedoes against the side of a battleship without danger to the attacking party, such craft have every advantage. They have not been perfected yet to a degree that enables them to make long voyages, but the present success is sufficient to promise great improvements in the future.

THE SUBMARINE VESSEL.

The French experiments have been successfully achieved through the skill and genius of Gustave Zádé, an inventor of Toulon, who has built two interesting craft of which the latest, named for himself, is the most successful. This latter boat is 147 feet long and is propelled by electric motors with storage batteries. The hull is cigar-shaped, with very sharp ends, and the speed is eight-and-a-half knots an hour below, and fourteen knots above the surface. A crew of ten men is carried, with compressed air, stored in tanks, enough to last them while below. Torpedoes may be discharged from an opening in the bow of the boat. This vessel has been operated in deep and shallow water with remarkable success, and has made trips up to seventy miles without difficulty. All of these sub-

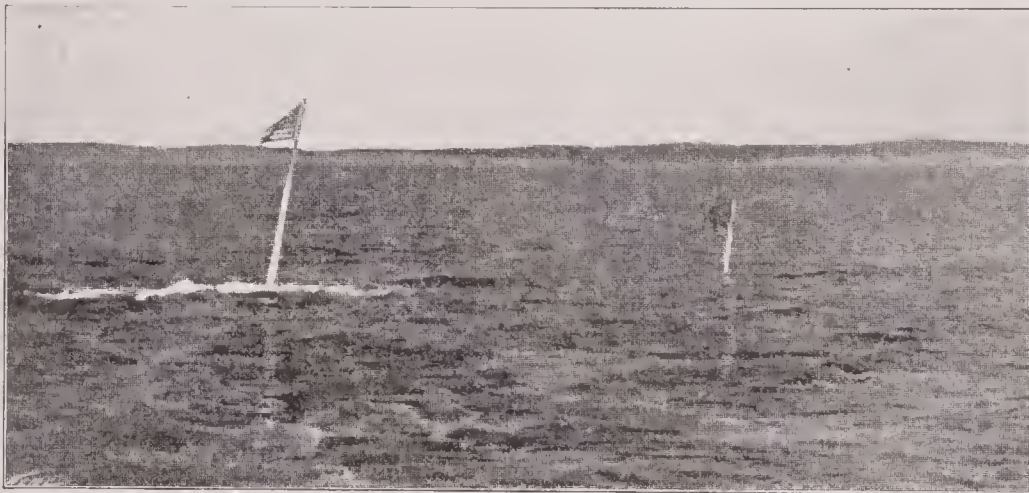
marine craft are operated on the same general principle, being sunk by admitting water to tanks provided for the purpose, and raised to the surface again by the buoyancy of these tanks when the water is pumped out.

For warfare in the interior of uncivilized countries, the light-draft armed vessel also has been brought to a high degree of adaptability. The British in Africa use what they term an armored canoe, although the word canoe is a misnomer. It is a heavy steam launch, covered with boiler iron, and with shields to protect the men and the rapid-firing machine guns which it carries. Such a boat can penetrate the African jungles by way of the rivers and can assist in campaigns against savage tribes who could with difficulty be reached at all by the trails through the forests. The United States, like other powers, utilizes light-draft gunboats for service in the rivers and archipelagoes of the Asiatic coasts, and the Pacific islands where such service is needed. The rivers of China and Korea, at the time of native attacks on foreigners, have been the frequent scene of such operations.

In order to still more facilitate the operations of warships at sea, a device has been invented by which the fighting craft may take coal without making port. Wire cables are strung between the masthead of the battleship and the collier, and upon these cables iron baskets are hauled back and

forth until the coal is transferred. This is an application of the trolley system by which ore and coal are conveyed from mines to cars for shipment, where valleys and hills intervene. Experiments with this method of coaling have been made in the American navy and in the British navy, and in moderately rough weather forty tons per hour have been taken aboard a battleship from a collier. With practice it is believed that this speed can be greatly increased, and such embarrassments as hampered the American navy in the Caribbean during the late war will be eliminated.

The improvements in the appliances of warfare thus briefly indicated are typical of others upon which students of the arts of war are engaged. In these ante-millennium times, war is occasionally a necessary contingency, and when it comes we want the best tools we can get to fight with.



SUBMARINE BOAT "HOLLAND" DIVING.

It is a crime for a nation not to be prepared for war, a crime against those who will be called upon to defend her in time of war. It is a crime for a nation not to be abreast of the times in arms and equipment. At best war is cruelty, but it is not only often a necessity but unavoidable, and, once engaged in, should be made as destruct-

ive as possible, in order that it may be brief as possible, thus minimizing the evil in the aggregate.

The approximate dates of the completion of the new battleships and cruisers of the United States were given by the Secretary of the Navy at the beginning of 1902 as follows: battleships: Maine, October, 1902; Missouri, March, 1903; Ohio, May, 1903; Virginia, May, 1904; Nebraska, July, 1904; Georgia, July, 1904; Rhode Island, July, 1904. Armored cruisers: Pennsylvania, January, 1904; West Virginia, February, 1904; California, August, 1904; Colorado, January, 1904; Maryland, February, 1904; South Dakota, August, 1904.

With the completion of the above, the navy will have seventeen battleships and eight armored cruisers. The total number of warships of all kinds under construction at the same date was fifty-nine, including

besides those mentioned, nine cruisers, four monitors, twenty-five torpedo boat destroyers, nine torpedo boats and seven submarines. In addition to these, the navy in commission at the same date included eleven men-of-war of the first rate, meaning above 8,000 tons; fifteen of the

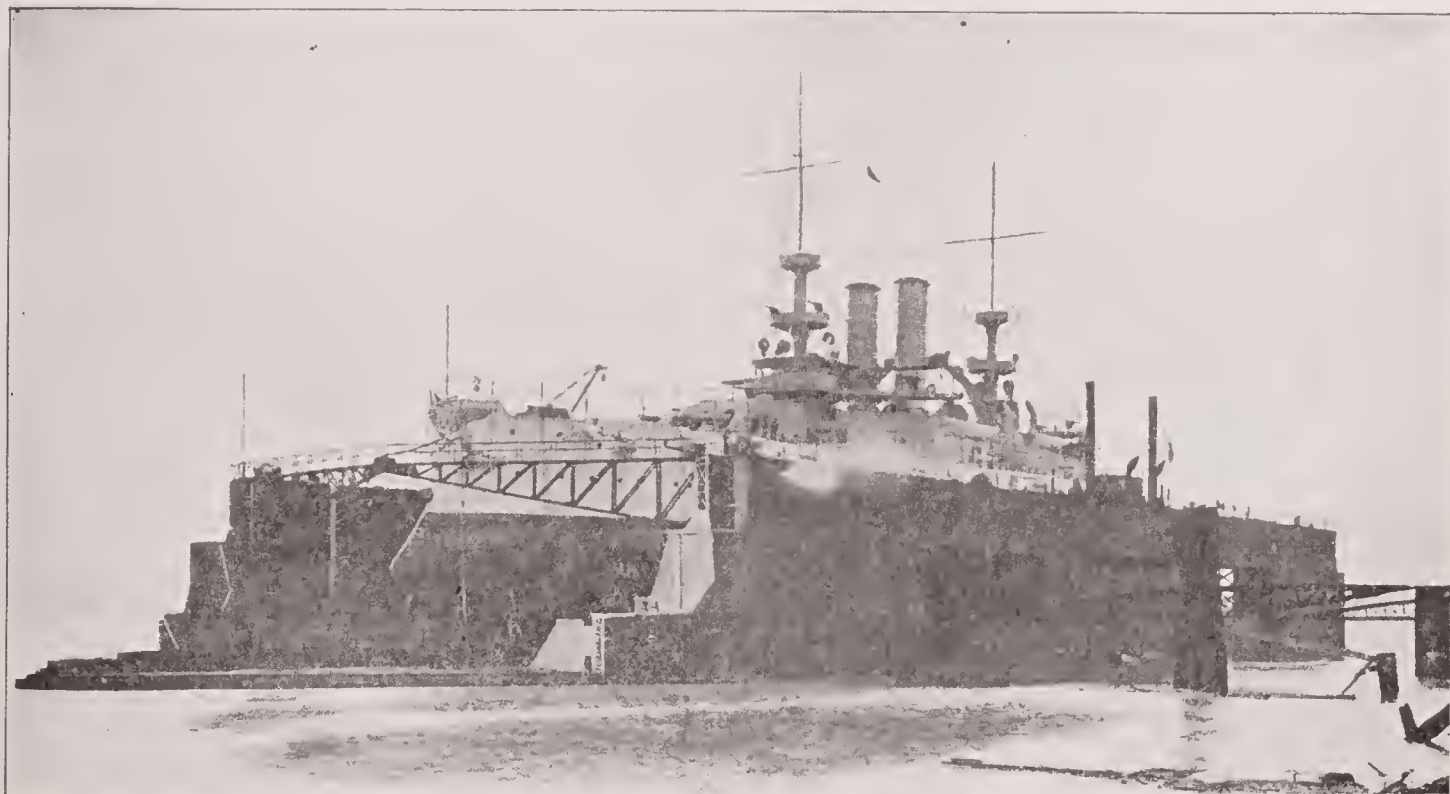
second rate, or between 4,000 and 8,000 tons, and about eighty of less size, including monitors, cruisers, gun-boats and torpedo boats. The best calculations therefore credit the United States with being fourth among the powers in naval strength, surpassed only by England, France and Russia, and followed by Germany, Italy and Japan.

FLOATING DOCKS FOR MEN-OF-WAR

The immense increase in the size of men-of-war in the last few years has compelled the rapid increase of repair and supply and equipment stations wherever such vessels are to sail. The navy without proper equipment would be as bad as no navy at all, and so every country has found it necessary to seek a favorable location for coaling stations all over the world. In time of war, the fighting ships of the hostile powers are limited in their privileges in neutral ports. For instance, they are permitted to take on board only sufficient coal to enable them to steam to the nearest port of their own country, and that privilege can not be duplicated at a later time during the progress of hostilities. Powerful and threatening as a great battleship is, there can be nothing more helpless than such a craft

either out of coal or disabled for want of some facility of repair.

The prime requisite for well-equipped navy yards is a dock in which even the largest vessels may rest while they are being overhauled. There are two types of such docks, the drydock which is built on land, with gates by which the water may be admitted and released at will, and floating docks, for use where the other type is not available. Like other powers, the United States has found it necessary to extend its docking facilities, and the great structure pictured herewith is the newest one of all. This floating dock is located at Algiers, across the Mississippi River from New Orleans, although such craft may be taken from port to port at will. In the illustra-



FLOATING DOCK SHOWING BATTLESHIP ILLINOIS IN PLACE.
This dock was built by the Government for use at New Orleans.



LAUNCHING A GREAT FLOATING DOCK.

This dock was constructed at Wallsend-on-Tyne, for use in Bermuda.

tion, the new battleship Illinois is seen in the dock high out of the water.

In spite of the great size of the floating dock, the method of its use is simple enough. The general shape of the peculiar structure, if it were cut right through to show a section, is that of a great letter U, but on the outside it is rectangular, the curve of the U occurring only on the inside. The great bottom and sides of it are hollow, and under ordinary circumstances it floats high on the water. When it is desired to take a vessel into the dock, the great pontoons, which are enclosed in the bottom and the lower part of the sides, are pumped full of water, so that it sinks to whatever depth is required to permit the admission of the ship. With the end gates open, the ship is now moved cautiously into the dock, and braced in place, after which the water is pumped out of the pontoons. As the dock rises, of course the vessel rises with it, until at last it is entirely uncovered and ready for whatever repairs are necessary. In order to release the ship from this position, the same process is reversed. In the picture, one

obtains a striking view of the bottom and bow of the Illinois and its projecting "ram." The peculiar trusses extending from the side of the dock to shore are hinged at each end so that although the dock may rise and fall with the tide or the weight of vessels, it still maintains its position in reference to the shore. Another new floating dock which came into service for the American navy is the one at Havana, which was built at Birkenhead for the Spanish Government in 1887, and cost nearly \$600,000.

The other illustration shows the launch of a new floating dock constructed in England for use in Bermuda. This dock is 545 feet long, the side walls are fifty-three feet high, and the total width of the structure is 130 feet, with 100 feet between the walls. This dock is capable of lifting out of the water a ship 17,500 tons in weight, and drawing thirty-two feet of water. This dock cost \$1,150,000, of which \$175,000 measured the cost of towing it across the Atlantic Ocean to Bermuda.

THE FIRST CABLE ACROSS THE PACIFIC OCEAN

Now that the political and commercial sway of the United States extends far into the Orient, it is necessary to connect the nation with its remote dependencies by steamship lines and submarine cables under our own control, so that communication may be uninterrupted at all times. Steamship lines, in fact, are already established between the Pacific coast of the United States and our island possessions of Hawaii, Samoa, Guam and the Philippines. In order to accomplish the other purpose, Uncle Sam is about to spend 9,000,000 good American dollars for copper wire, gutta percha, jute yarn, tar, and steel wire. When this money has been spent and a fleet of ships and a thousand electricians and engineers have finished their work, the Philippines and the United States will be within half a minute's talking distance of each other.

The cable which will establish this communication will be the first to span the Pacific, and almost triple the length of the longest submarine wire ever laid. From San Francisco to Manila, with stops at Guam and Honolulu, the distance is nearly 8,000 miles.

The making of this great stretch of cable is a colossal task. About 22,740 tons of material will be required—1,980 tons of copper wire, 12,000 tons of steel wire, 2,300 tons of jute yarn, 4,300 tons of compound and tar, and 1,260 tons of gutta percha. This means a total weight greater than that of forty-eight locomotives of standard size.

Most people know in a vague, general way that the submarine wire is about an

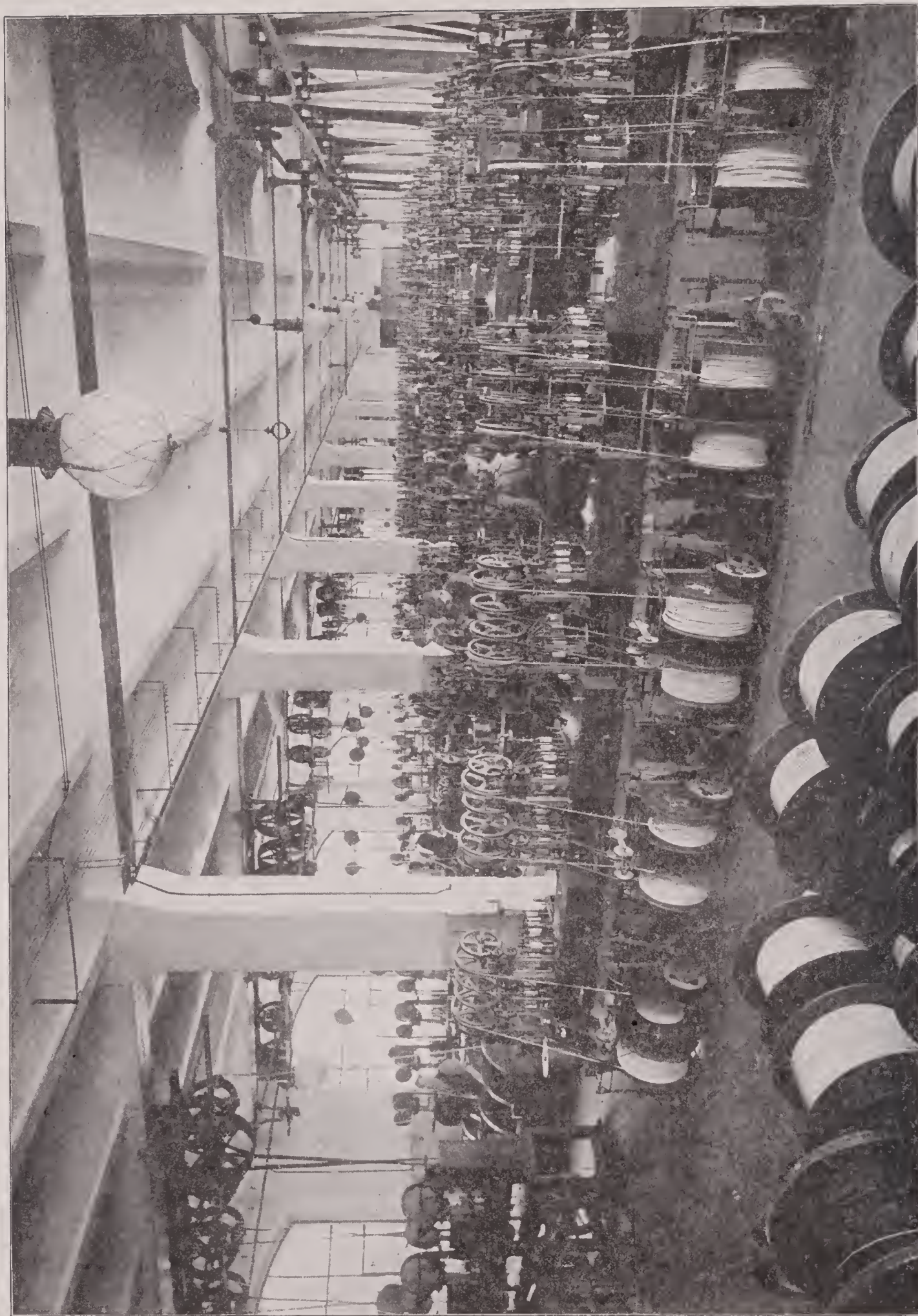
inch thick, and that it resembles, more than anything else, the underground cable which in some cities operates the cable cars. Few people, however, have any idea of the inner construction or of the ingenious processes by which the delicate copper wires that carry the electric current are so protected that they lie for years and years on the oozy bed of the ocean, and do their work with practical immunity from breaks, accidents or interruptions of any kind.

The cable is composed of three parts: the copper strand; the hemp, tar and rubber casing which protects them from the water, and the heavy steel binding that acts as a shield against rocks, wreckage, the keels of ships, and the sharp teeth of ocean monsters.

The first step in the making of a submarine cable is the preparation of the copper wire. After the wire has been weighed and tested it is taken to the winding drums. Here it is rapidly reeled around large, spool-like devices called bobbins. From the winding room the wire goes to the stranding room. Here the seven wires are twisted together and united on the cable stranding machines.

The thin metal threads which are destined to flash under the water messages for which, perchance, a world will wait breathless, are now ready for their first sheathing. This consists of insulating material, jute being usually employed.

In applying the jute water is used, and as the least moisture would render the cable useless, a very careful and thorough system of drying is employed. The jute-covered wires go through vacuum drying-boxes,



MACHINES FOR BRAIDING WIRES INTO SUBMARINE TELEGRAPHIC CABLES.

which evaporate the last vestige of moisture. From the drying-boxes the wire passes to caldrons filled with insulating material. Here the wire is allowed to steep until the covering has become so thoroughly impregnated that there is no chance of any of the electric current leaking out, after the cable has finally been consigned to its watery resting place. The first stage of the work is now completed.

Next comes the making of the gutta percha jacket. Despite its great cost, gutta percha will be used in the Pacific cable, for it has been found to give a better result than any other form of casing. From time to time cable manufacturers have utilized various rubber compounds as substitutes. These all have to be vulcanized by heating and kneading with sulphur or some sulphuric preparation, to deprive the rubber of its adhesive qualities. Even at their best none of the rubber compounds has been found to equal gutta percha.

In preparing gutta percha the mass of the crude material is first heated and kneaded by a special process, till it becomes plastic. The softened, pliable heap is then taken to the press, where it is to be united with the copper cable wire. By the use of suitable nozzles the gutta percha is deftly pressed around the strands in the form of a seamless jacket. Here again the greatest care is taken to have the covering air-tight and moisture-proof; for the least drop of water finding its way into the wire would produce disastrous results.

Now the cable, consisting, at the present stage of its construction, of the copper wire strands and jute and gutta percha coverings, passes over rollers, partly through the open air and partly through a long tank containing water. The purpose of the lat-

ter is to harden the gutta percha. The cable is then subjected to a final rigid test, and if the insulation is perfect it passes to the armaturing department. The second stage is finished.

The third and final process is administered by the armaturing machine. To this powerful contrivance is allotted the task of putting on the shield of steel wire. The big machine works with an almost human intelligence and handles the heavy ropes of steel wire as deftly and as easily as a sewing machine manipulates threads of cotton. Over the metal casing is spun a protecting fibre, which is then impregnated with insulating material. It is the purpose of this insulated fibre to protect the armature from the destroying effects of the earth and water. After being drawn through a bath of lime water, which destroys the adhesiveness of the impregnated fibre, the cable is wound upon large wooden rolls and is ready to be taken on shipboard. In so far as human genius can make it so, the cable is protected against any injury from the elements or the denizens of the deep.

Much of the work preliminary to the laying of the cable has already been done. The United States ship *Nero* has taken probably a thousand soundings to determine the depths and character of the bottom from our western coast to the Philippines.

Four vessels, each having cable tanks forty feet in diameter and holding about 1,000 miles of cable, will do the work of handing over the wire to old Neptune's embrace.

When the cable is finished, a greater step toward the pacification of the Filipinos than the despatching of regiments of soldiers will have been taken. Through ready communication the natives can more

readily be made to understand the character and purposes of the American people. The convenience the cable will be to the business man and the impetus it will give to the transpacific commerce are almost past computation.

At the present time, if a San Francisco merchant wants to communicate with Auckland, New Zealand (the most expensive place in the world to reach by wire), the message transmitted must travel across the United States from San Francisco to New York, then to London over one of the At-

lantic cables, and then be forwarded successively over the lines of the Eastern Telegraph Company and the Eastern Extension Telegraph Company to Suez, Aden, Bombay, Singapore, Adelaide and Sydney to Auckland. In short, to send a message between two points only 8,000 miles apart it would be necessary to pass over 26,276 miles, or more than the circumference of the earth.

But when Uncle Sam gets his cable this will all be changed.

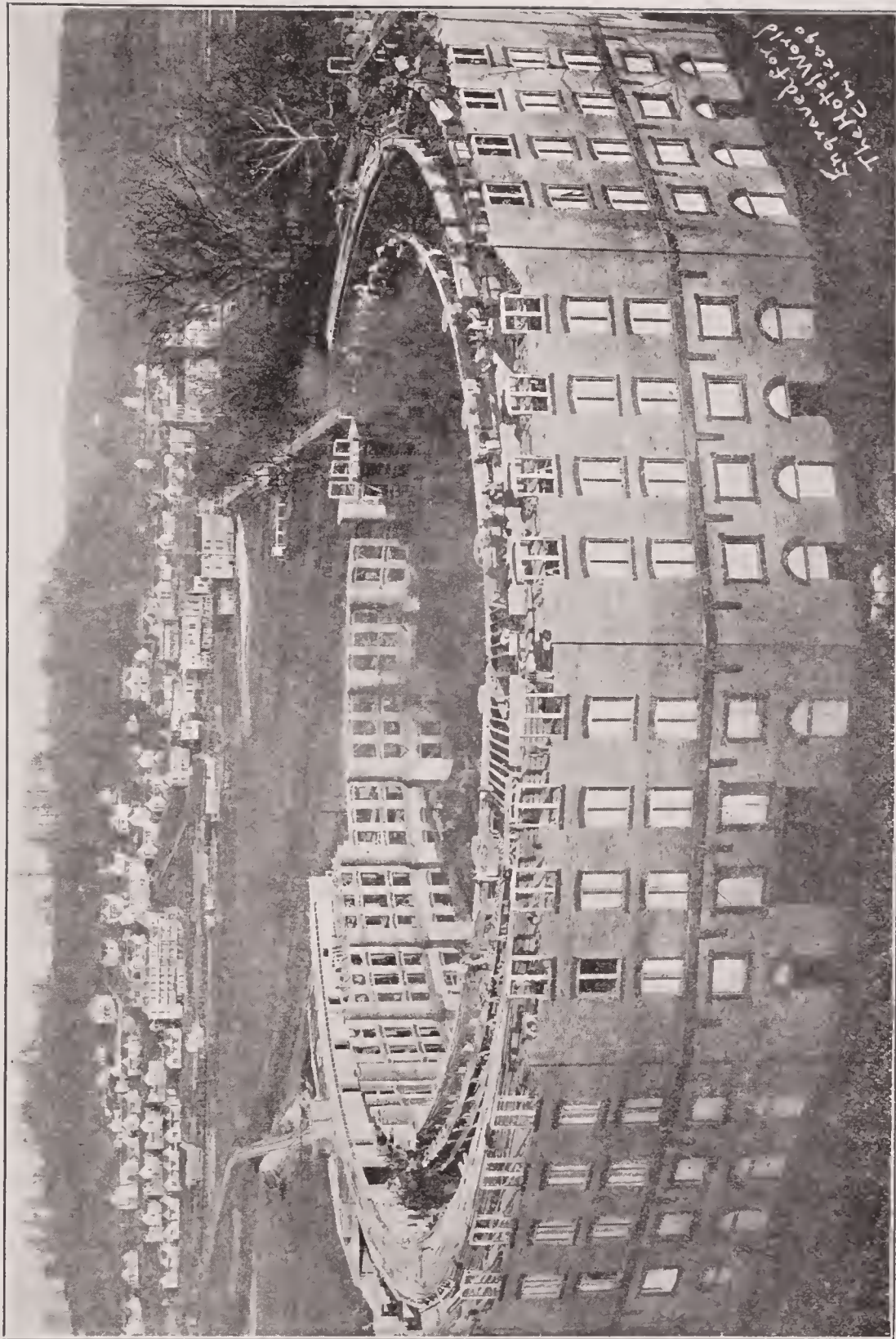


UNIQUE NOVELTY IN HOTEL CONSTRUCTION

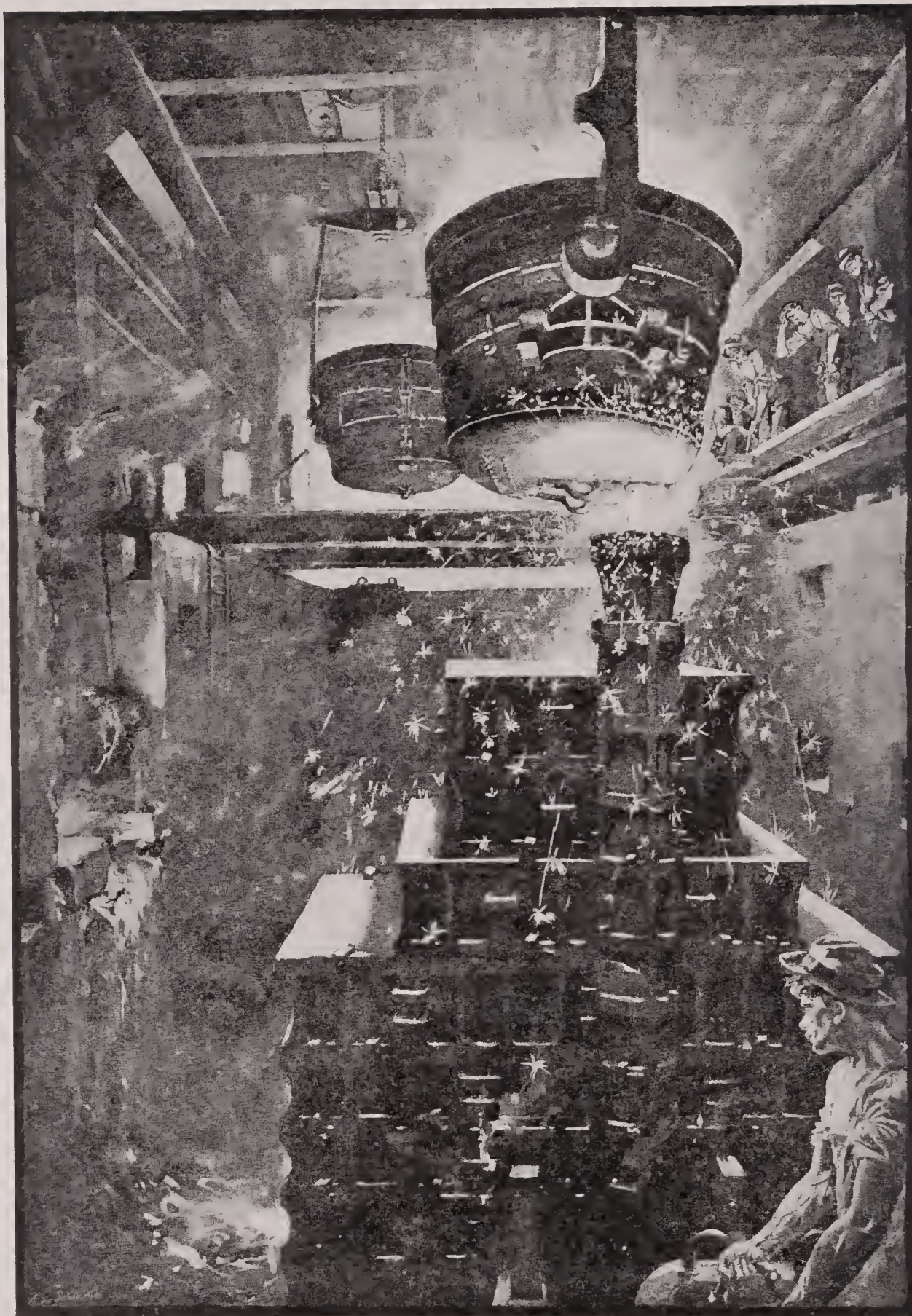
It is an odd hotel that stands at West Baden, Indiana, for the reception of great numbers of tourists who visit that popular resort every year. It is a multi-sided structure, enclosing a great courtyard which is surmounted by an enormous glass dome 200 feet in diameter. The building is oval in its general shape, the dimensions being 634 by 343 feet, a size which of itself makes the structure noteworthy. The rooms of the hotel are not as eccentric in form as the shape of the building suggests. They are rectangular, after the ordinary fashion, the

wedge-shaped spaces that result from the circular form of the building being utilized for closets and bath rooms. The photograph from which the accompanying illustration was made was taken when 500 men were at work on the building. Its predecessor in the great resort was burned, and this hotel was built on a much grander scale in order to accommodate the increasing patronage. It shelters several hundred guests of the numbers who seek the mineral springs of the famous Indiana resort.

L. of C.



UNIQUE NOVELTY IN HOTEL CONSTRUCTION.



MAKING A STEEL CASTING.

The molten metal is discharged through an orifice in the great kettle, swung over the molds, and flows in a fiery stream to the place prepared for it.

IRON AND STEEL INDUSTRIES

Steel is the material from which this industrial age builds its marvelous machinery, its great buildings, its railways and its steamships. Steel, it is, upon which our multi-millionaires have built their fortunes, fortunes which excel all wealth in the history of the world. The steel trust, it is, the formation of which has done more than any other single influence to draw the attention of the public at large to the enormous consolidations of capital for the dominance of the industrial world, not alone in America, but all over the globe. So it

becomes of prime interest and importance to observe the progress of the industry and its products from the mine to the consumer.

There is a wide distance between the primitive miner and molder of prehistoric times, with his rough furnace, his rude appliances, and the customers of his neighborhood, and the remarkable organization of mines, transportation facilities and manufacturing plants which now unite to form the great iron and steel interests. The United States Steel Corporation, as the trust is officially entitled, with its capital



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ORE DOCKS AT ASHTABULA, OHIO.

of \$1,100,000,000, is by far the greatest organization in the world. And yet it does not include by any means all the branches of the industry in America and the foreign fields, in which other great organizations exist. Organized by J. Pierpont Morgan as prime mover, and including such stockholders as Andrew Carnegie, John D. Rockefeller, Marshall Field, and other national

rails, structural steel, bridges, armor-plates, tin, sheet steel and tubes. It is readily seen that the ramifications of such an industry become world-wide.

The processes of iron mining, where ore is produced on a large scale, differ materially from those of coal mining or the mining of other metallic ores such as gold, copper, lead or zinc. The most noteworthy



BIRD'S-EYE VIEW OF A GREAT PENNSYLVANIA STEEL MILL.

characters, the very volume of its capital and the diversity of its interests has made it world-famous. Its president, Charles M. Schwab, has been reputed to receive \$1,000,000 a year salary, although it may be doubted whether this information is accurate. The functions of this corporation include the mining of iron, the transportation of it to its own mills of many different kinds and in many locations, and the manufacturing of it into almost every product of iron and steel that is demanded on a large scale, particularly railway

iron region of the United States is that around Lake Superior, in which the three states of Michigan, Minnesota and Wisconsin yield more than two-thirds of all the 16,000,000 tons of iron ore produced annually in this country. Michigan alone contributes nearly 6,000,000 tons of the product, and Minnesota follows with nearly 4,500,000 tons. Alabama is the third state in production, yielding more than 2,000,000 tons annually, and then follow in succession Virginia, Pennsylvania, Wisconsin and Tennessee, ranging from 860,000 tons

down to 535,000 tons. The dozen other states where iron is found commercially do not yield a total product, among them all, of more than 1,000,000 tons. Comparing this product in the United States with that of the world, which amounts to something more than 63,000,000 tons a year, we find that our country produces more than one-fourth the total, and more than its nearest competitor, which is Great Britain, with about 13,000,000 tons. Germany follows closely upon Great Britain, but no other country except Spain even passes the 5,000,000-ton mark.

The remarkable iron ranges of the Lake Superior region are peculiarly available because of their proximity to the great lakes, by which the product may be shipped directly and cheaply by large steamers to the manufacturing regions of Ohio and Pennsylvania, where abundant coal is found and where great mills have been built. Three distinct iron ranges in Michigan are recognized, all in the upper peninsula, and trending nearly east and west. These are the Marquette, Menominee and Gogebic ranges. The first shipments of ore from these deposits were made in 1856. Bessemer, Ironwood, Hurley, Republic, Champion, Ishpeming, Negaunee, and other towns in this part of the state and in the edge of Wisconsin have become famous the country over for the remarkable mineral wealth they have yielded. Escanaba, Manistique, Marquette and Ashland are the shipping ports on the great lakes, from which this product is sent.

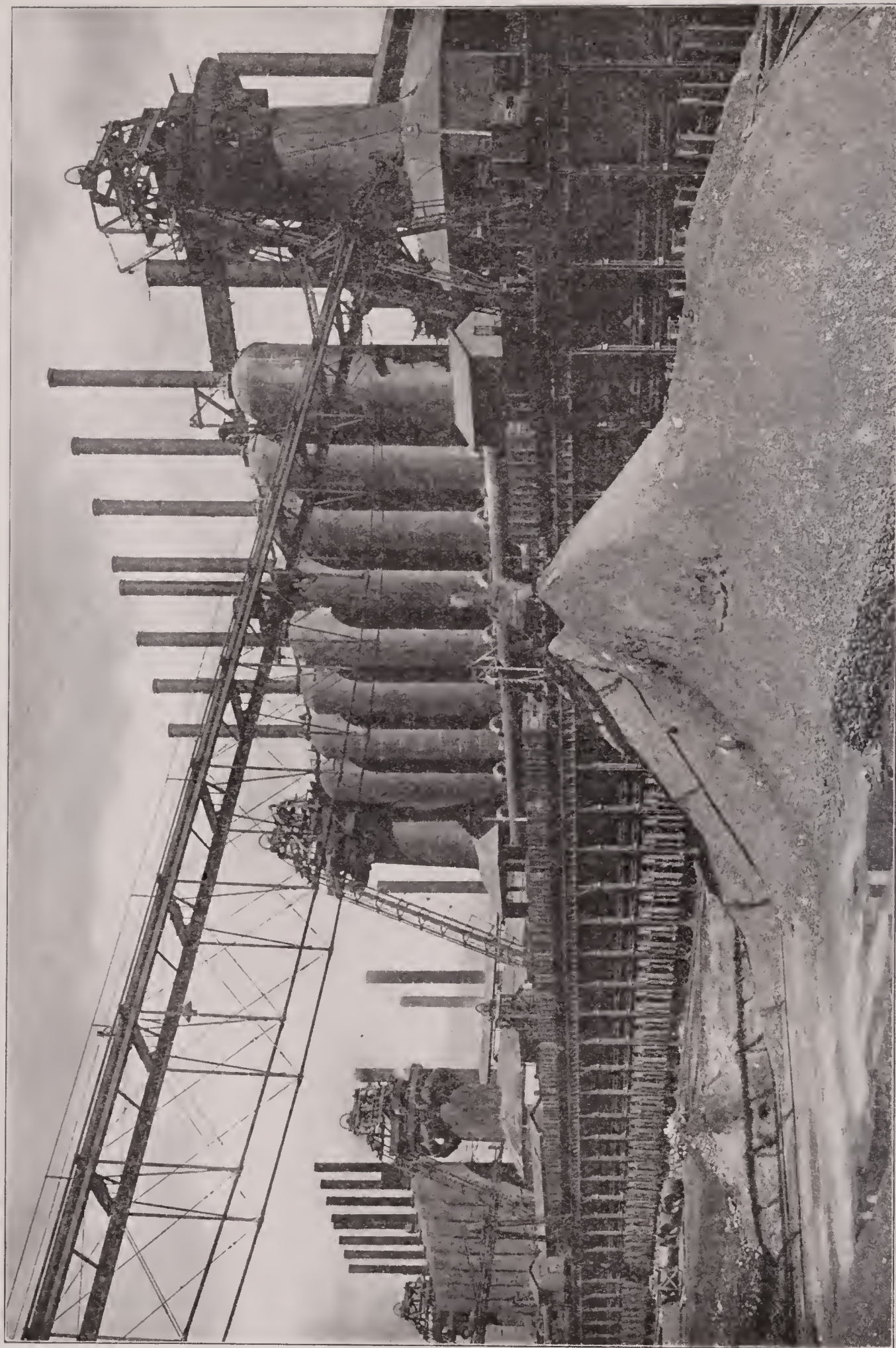
Two iron ranges in Minnesota, the Vermilion and the Mesaba, lying north of Duluth, furnish the iron from this state. The most important mining points are Ely, Tower, Virginia, Hibbing and Biwabik.

Their shipments are made from Duluth and Two Harbors.

Most of the iron ranges of the Lake Superior region can be worked by stripping off the surface deposits and useless vegetable mould, and worthless mineral substances, and then digging the available ore from the open pits. This becomes quarrying rather than mining, as the word is generally understood, but though it may lack some of the more picturesque features of mining operations deep in the earth, it is much more convenient commercially, and makes the cost of the product far less than it would be by way of shafts and tunnels.

The brown ore is carried down to the lakes from the mines in an almost endless succession of trains, and dumped on the ore docks or loaded directly upon vessels waiting for it. Scores of great cargo carriers ply from these ports on the upper lakes down to Lake Erie, carrying their store of Lake Superior iron ore for the Pennsylvania and Ohio furnaces. This single industry employs a very large proportion of the fleets on the great lakes. At the other end of their route they deposit the cargo once more upon the docks of the manufacturing town, or into the railway cars that are to carry it inland to smelters and blast furnaces. The processes of loading and unloading these cargoes between ship and train have become so perfected by the use of mechanical appliances, that thousands of tons may be handled within a very few hours.

The iron and steel industries of Pennsylvania so far lead all others, that a view of them will serve to characterize the whole country. Annually the Keystone State produces 60 per cent of all the steel of the United States, 50 per cent of the pig iron



BLAST FURNACES OF A GREAT STEEL MILL.

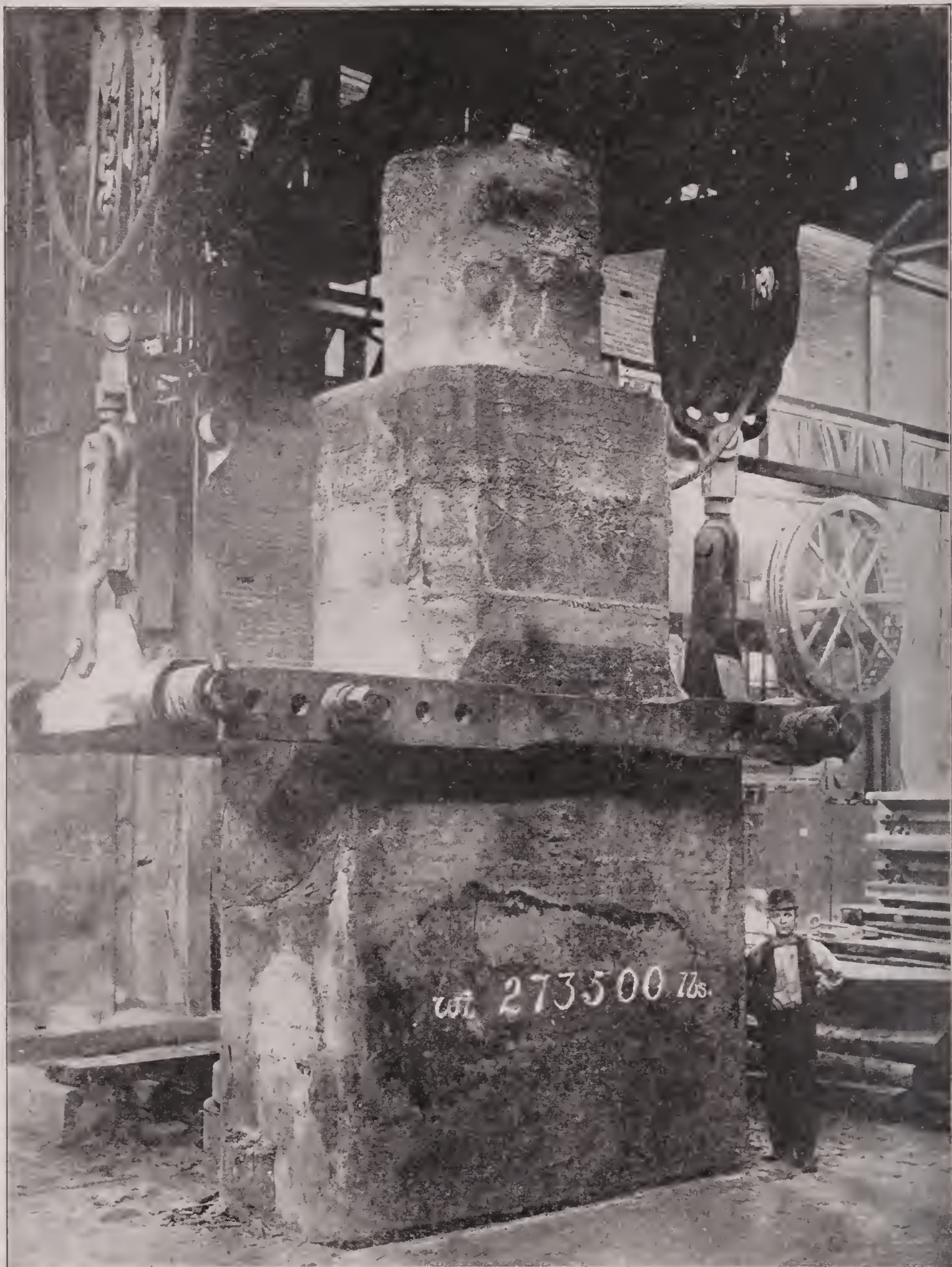
and over 40 per cent of the tin plate. The output of pig iron annually approaches 5,000,000 tons, with a value of more than \$50,000,000. The steel output is nearly 4,500,000 tons, and the total value is about \$125,000,000. Blast furnaces, rolling mills and steel mills of every variety help to bring wealth to the state. The crude iron ore as it comes from the mines is taken through all the necessary processes, until it becomes the finished product, for use in complicated machinery, for bridge building, or for railway construction.

The ore as it comes from the mine is mixed with earth, rock, sand and other mineral substances which must be removed, and the first form it takes is that of pig iron, ready for the foundry. There is a melting room in which is a great cupola, cylindrical

in shape, standing erect like a huge vertical boiler and lined with fire brick. A coke fire is started in the bottom of the cupola, and on top of the fire is dumped a mass of iron ore, alternating with lime and coke. There is a blast pipe below, through which a strong draught is driven, and a stack above from which the smoke and gases escape. The metallic iron melts out of the ore by the action of the heat, stimulated by the blast, and the lime takes up such impurities as cannot be removed by the heat itself. The metallic iron, melting, runs to the bottom of the cupola, where it accumulates in a liquid mass. The floor of the great room is made of sand, in which long troughs are marked, connecting with a main channel. When the iron is all melted in the cupola, a spout below is suddenly



STEEL "INGOTS" AND "BILLETS" READY FOR MANUFACTURERS' USE.



A 137-TON STEEL INGOT FOR A MODERN GUN.

This is the form taken by the steel when the first casting is made in constructing heavy artillery for battleships or coast defense. From this ingot the great weapon is turned and bored.

opened, and the molten mass flows out in a fiery stream. In these troughs of sand it cools gradually and is broken off into proper lengths for convenient handling. This is pig iron.

sticking up from its chains. This passes it into the grip of a succession of great rollers, through which it is squeezed like a wet cloth through a laundry wringer, continually increasing in length and diminishing



MAKING CAR WHEELS—MOLDS READY FOR POURING.

The most complete manufacturing plants, however, convert their iron into steel directly, without permitting the pigs to cool, thus saving a second heating. Little cars lined with fire brick receive the melted iron, and carry it to the top of another cupola, which is the steel converting crucible. This is an even hotter blast, with steady currents of air and sometimes oil used to get the desired heat. Carbon, manganese, and other chemicals that produce the different varieties of steel, are added here. When the process is complete to produce whatever qualities are desired, the contents of the cupola are received into molds on the floor until cool enough to handle. The lump of metal is now a steel ingot.

If it is intended for railway rails, the molds are picked up by cranes and tongs, and the ingot is delivered to a continuously traveling platform or bed, with projections

otherwise. At last it takes familiar shape, and in a few hours from the time it left the cupola, becomes the finished railway rail.



OPENING THE MOLDS.



A FLOTILLA OF COAL BARGES ON THE OHIO RIVER BELOW PITTSBURG.

COAL MINING AND COKE MAKING

Deep down in the earth, thousands upon thousands of men are working day and night, mining the coal which is an essential factor in the whole industrial activity of the world. With all the new forms of power that have been devised by ingenious inventors of late years, it has not yet proved possible to eliminate or even to reduce the uses of coal. Electric power, except in those isolated instances where it is generated by a water-fall, requires, somewhere, that great furnaces and boilers shall be employed in the first instance. Electric light may partially supersede gas, and so reduce some of the coal consumption in this direction, but the coal must be burned to produce the power which drives the dynamos. The burning of wood for fuel has been greatly reduced, owing to the deforestation of large areas, and a resulting greater demand has been made upon the coal-bearing regions. The settlement of our immense prairie states, where cold rules through a long winter, has likewise shared in the stimulus to coal mining. And industrially, the enormous growth of manufacturing enter-

prises and the extension of railways has been a factor of prime importance in the coal trade of recent years.

Cautious scientists more than once have expressed alarm over the threatened exhaustion of the world's coal supply. And yet it appears true that the economical utilization of coal by improvements of power applications, will more than counterbalance the increased consumption of the essential fuel, and that after all nature will preserve a balance in some way. Great areas are known to exist where coal is plentiful, hardly yet touched by the miner's hand. Siberia and

the Chinese Empire are noteworthy examples of this. Petroleum fields, yielding apparently limitless quantities of fuel oil, have been discovered in many parts of the world, and except on the shores of the Caspian Sea have been made use of hardly at all. Texas, the Mexican peninsula of Lower California, Central Siberia, the East Indies, and the mid-Australian desert, come into this category. Such natural forces, eternal and world wide, as the winds, the tides of the ocean and the



COAL MINER WITH SAFETY LAMP.



"DRIFT" AND "TUNNEL" IN A COAL MINE.
(Showing the tram cars loaded with coal ready to be taken out of the mine by way of the railway tracks.)

heat of the sun, are attracting the attention of great scientists as offering rich supplies of power for man's mechanical use as soon as science finds the way. Under such conditions as these, thus briefly outlined, it seems a needless anxiety to concern ourselves to-day with the possible exhaustion of the world's fuel supply in the course of a dozen centuries.

The first use of coal for industrial pur-

into the earth as some in the old world. The deepest coal mine known is near Tournay, Belgium, extending 3,542 feet into the earth. The deepest coal shaft in England is in the Dunkirk mine of Lancashire, which measures 2,824 feet.

Pennsylvania so far leads all other states of the union in its production of coal that a description of the industry there will serve to characterize it throughout the coun-

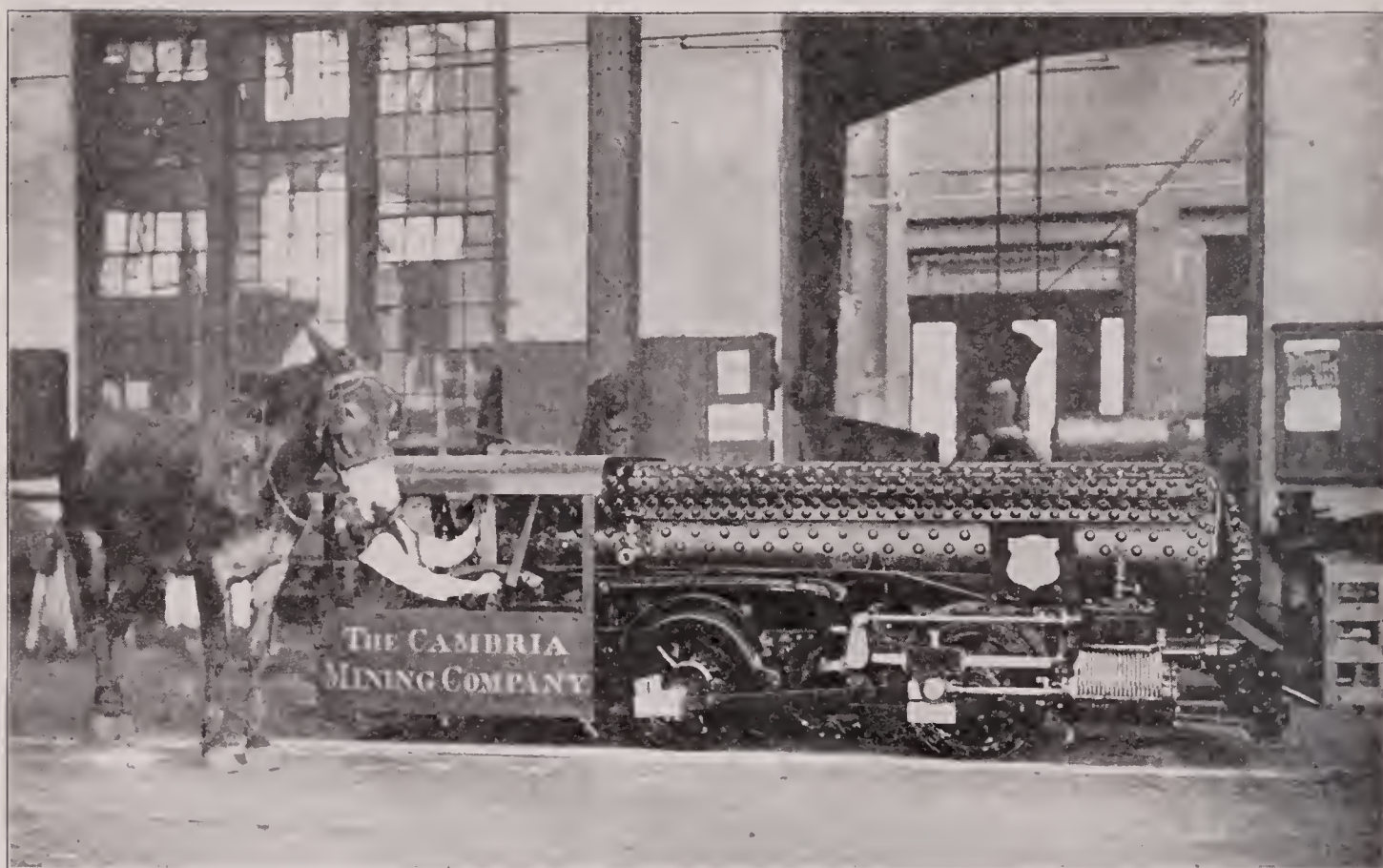


DOWN IN THE TUNNEL OF A COAL MINE.

poses in England was in the year 1234, if the records are truthful. After nearly 700 years, England still leads in the production and use of coal, being the only country exceeding the United States in the extent of the industry. The annual output of coal in Great Britain is more than 200,000,000 tons, while that of the United States is approximately 195,000,000 tons every year. Our American mines, being of more recent development, have not penetrated so deep

try. Its total product is always more than half that of the entire American yield from all the mines, and exceeds annually 105,000,000 tons. So commanding is this industry in the Keystone State that the popular mind always associates the state and the product, and Pittsburg has gained the name of the Smoky City, thanks to the great manufactories and mines operating in its vicinity.

Coal was discovered in the Schuylkill dis-



MOTIVE POWER IN A MINE—PAST AND PRESENT.

(The compressed air engine, by its additional strength and safety, is gradually displacing the mule in coal mines.)

trict in 1790, and thirty years later the first regular shipment was made to Philadelphia. Two kinds of coal are mined, anthracite and bituminous, or, more popularly speaking, hard coal and soft coal. The area from which the former is produced measures less than 500 square miles, and that of the soft coal nearly 9,000 square miles. But the former excels the latter slightly in tonnage produced, and by its greater value per ton exceeds the soft coal more than two to one in total value.

Let us now glance at the processes by which coal is mined in the heart of the earth, brought to the surface, and distributed to the market. Down deep in the earth stands a grimy miner. On his cap is mounted a small lamp, surrounded by a screen, which throws a faint gleam of light around him and permits him to see the

walls of black against which his efforts are directed. The lamp was the invention of Sir Humphrey Davy, and protecting the flames as it does from direct contact with inflammable gases which are frequently found in mines, goes far to avert the danger of explosion. This Davy safety lamp has been a factor of prime importance in making possible mining operations in many places otherwise too dangerous to work. With pick and shovel the miner labors, breaking down the coal, and gradually enlarging the subterranean chamber in which he is working. At intervals blasts of giant powder and dynamite are used to loosen and shatter great masses of coal. When this is to be done, the miners retire to a distance and wait until the dust and gases scattered by the explosion have dissipated. Then they return to the face of the cutting which they

have been working, and continue their toil.

Most mines are compelled to use both vertical shafts and horizontal tunnels or "drifts," in the course of their operation. If the first opening is in the side of a hill, a tunnel may extend far into the earth before the descent by a shaft begins. If, on the other hand, the mine to be opened is not located so as to be reached by a tunnel, a vertical shaft is sunk at once to the necessary depth. From the shaft the tunnels or drifts radiate in whatever direction the coal measures lie, and at different levels, so that

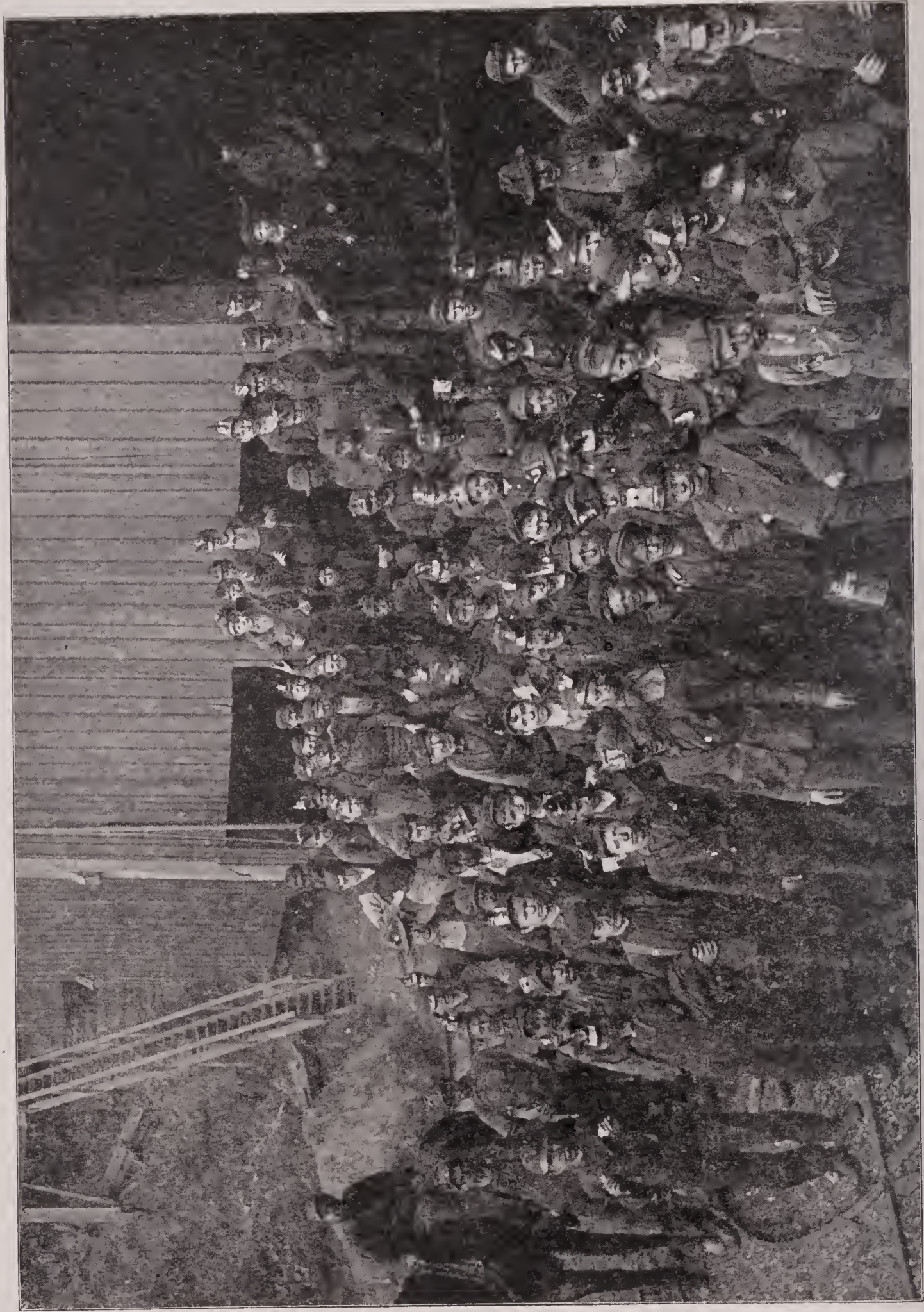
work may be carried on in many places at the same time. Tracks are laid in all these tunnels or drifts, and on these, little tram cars run back and forth, to carry the coal to the surface. When they reach the shaft, they must be hoisted by powerful machinery on the outside.

In European mines, women and children are often employed to push these cars back and forth, but in the United States, horses and mules are used. Even these in some mines have been superseded by locomotives, operated by compressed air. Such loco-



A GREAT COAL "BREAKER."

This is the building through which coal passes on its way from mine to railway car. By screens and chutes it is cleaned and sorted into various sizes for market.



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"BREAKER BOYS" OR COAL PICKERS IN A PENNSYLVANIA MINING TOWN.

They begin at an early age and reach manhood as it passes through the chutes and screens. They begin at an early age and reach manhood

tives, to haul trains hundreds of feet underground, must be very different from those we are accustomed to see on our steam railroads. One of the greatest dangers the coal miner has to guard against is the explosion of fire-damp, which can be set off by a single tiny spark. It would not be possible, therefore, to use an engine operated by steam, with a firebox. The driving machinery of these novel locomotives is not unlike that of engines of the more familiar type. The air supply is gained from great tanks carried over the driving wheels, in place of the ordinary locomotive boilers. The storage pressure capacity of these tanks is 600 pounds per square inch, from which 200 pounds' working pressure is maintained upon the engine cylinder. The supply of air can be replenished readily in the

tanks, from nozzles connected with high-pressure pneumatic tubes placed at the points convenient for the purpose. Such a locomotive can draw long trains of cars, of which the mule can handle but one, and at much faster speed. It is thus that mechanical inventions are steadily improving the industrial processes in almost every line of business.

When the coal reaches the surface, either by tunnel or by shaft, it passes rapidly through a series of processes necessary to clean it, sort it into the various sizes or grades for the market, and bring it to the railway cars by which it is to be shipped to the place of sale. A great coal "breaker," as the peculiar structure is called where these processes are carried on, is a place of dust and noise, of rambling sheds, inclined



COAL FROM MINE TO MARKET.

(This illustration shows in striking manner a general view of a mine, including the entrance to the tunnel, the breaker, and the loaded cars ready for shipment, with the miners' houses in the background.)

planes, screens and chutes, a monster of architecture, but an important factor in the coal trade. The loaded cars right from the mines reach the breaker, high in the air, and are tilted so that they dump their cargo into chutes provided for the purpose. As the coal rattles down through the winding way provided for it, it passes over a succession of screens with meshes of various sizes. By this process it is sifted and sorted with mechanical precision until, finally reaching the bottom, each grade falls into the bins or

railway cars provided for it, ready for the market.

It is not enough to merely sort the coal into sizes. It must be cleaned as well, for few mines are free from slate and other impurities which would reduce the value of the coal if left untouched. As the coal passes through the breaker and over the screens, it is watched by keen-eyed, deft-fingered boys, who pick out and throw aside whatever pieces of slate or stone they discover. A "breaker-boy," as these

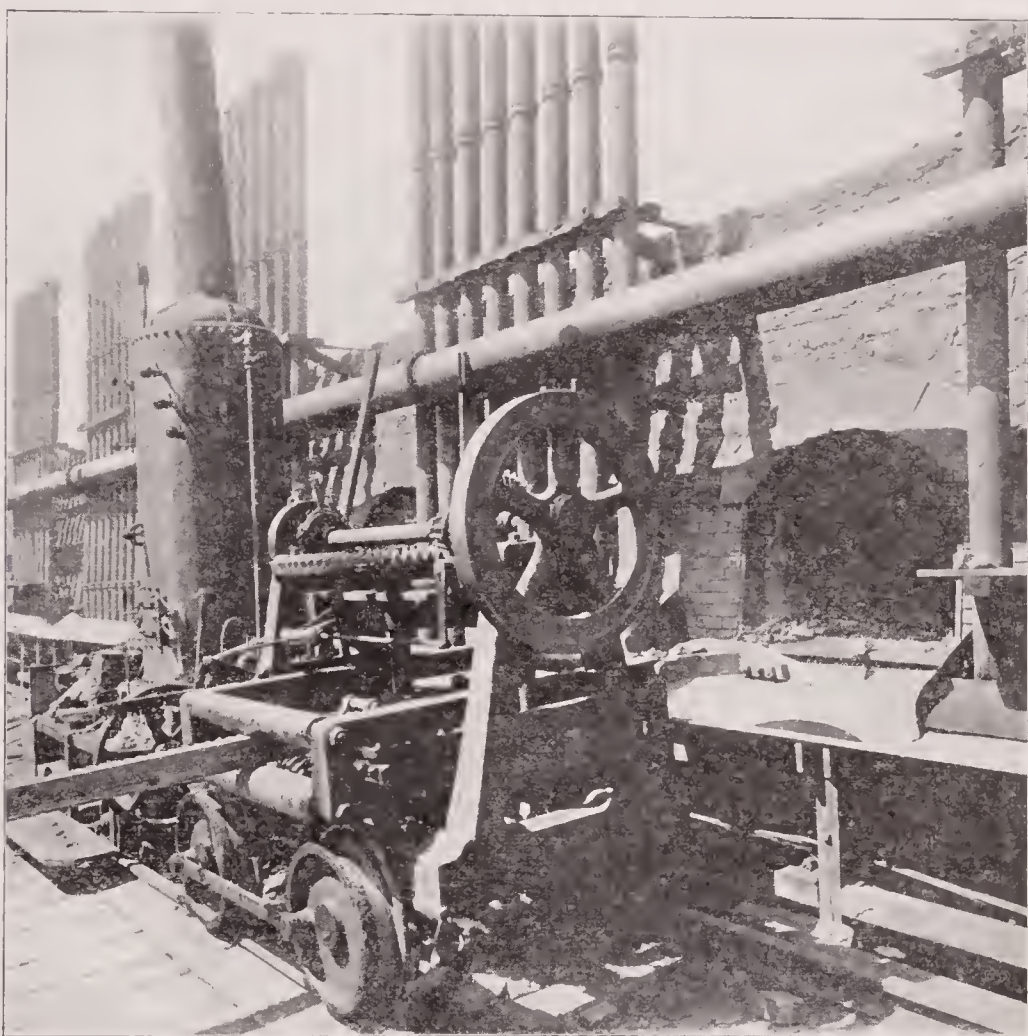


COKE OVENS.

(Far in the background men are seen with the apparatus which draws the coke out of the ovens. The product is then carried through the long trough by an endless belt and thence by another belt, shown in the foreground, to the shipping sheds.)

coal-pickers are called, is taking the first step in the life of a miner, and in every mining town there are numbers of such little fellows busily engaged and helping to earn the living for the household. The miners in many of our mining districts are foreigners, forming communities of their own and coming in touch but little with American manners of life and thought. Poor as they are, and beginning work at an early age, they have little opportunity to obtain more than the rudiments of an education. It is this element that forms one of the most difficult problems to deal with in our industrial and labor questions. The transportation of coal from mine to market is one of the most important and lucrative parts of the business of many great railways. In Pennsylvania, particularly, there are lines which are classified as "the coal roads" because this traffic forms such a dominant part of their entire business. There is a constant procession of coal trains between the mines and the large cities and manufacturing towns near them. Pittsburg and Allegheny are conspicuous examples of cities virtually built up by the fortunate combination of coal and iron areas convenient to them. Here, too, the Ohio River becomes an im-

portant aid in the traffic. Barges loaded with coal are lashed together, to form immense flotillas which are towed down stream on the Ohio, to such other markets as can be reached to advantage by that route. Ohio, West Virginia, Kentucky, Indiana, and indeed the whole of the Ohio



DEVICE FOR REMOVING COKE FROM OVENS.

(The rake-shaped fixture draws the charred coke out of the oven and into the trough, whence it is delivered as described in the accompanying view.)

and Mississippi Valleys, share in this distribution of the Pennsylvania product.

A very large part of the Pennsylvania coal product is converted into coke for use in the steel mills and manufactories where it is needed. The coke furnaces thus become a feature of the coal industry, and they have grown to immense proportions because of the demand of the steel trade.

The mechanical appliances used in the manufacture of coke have been improved so that virtually all the work from the mine to the railway car with the finished product, can be carried on by machinery. The coke is drawn from furnaces where the coal has undergone the roasting or charring process, by ingenious mechanism which works like a great iron hand on the end of a long steel arm. This is carried on a heavy car, which

anthracite or hard coal. Illinois is second in the production of bituminous, or soft coal, with more than 20,000,000 tons annually, and West Virginia is third. A large coal field exists in Georgia, where it is convenient to an iron-producing region. This condition, as in Pennsylvania, induces the development of a large coke district. Ohio, Indiana, Virginia, Iowa, Missouri and Colorado are other states in which the coal in-



LOADING COKE INTO CARS.

At the right are the ovens, with a trough in front through which the coke is carried by an endless belt. This discharges upon another belt on the incline in the background, and thus it is carried directly into the cars.

runs back and forth on a railway track in front of the row of furnaces. An engine mounted on the same car, furnishes the power for this giant hand, which rakes the coke from the furnace into a long trough. An endless belt in this trough forms a carrier, connecting with another one of the same kind, by which the product is loaded directly into the cars for shipment.

Pennsylvania, besides producing more than half of the total coal yield of the United States, furnishes virtually all of the

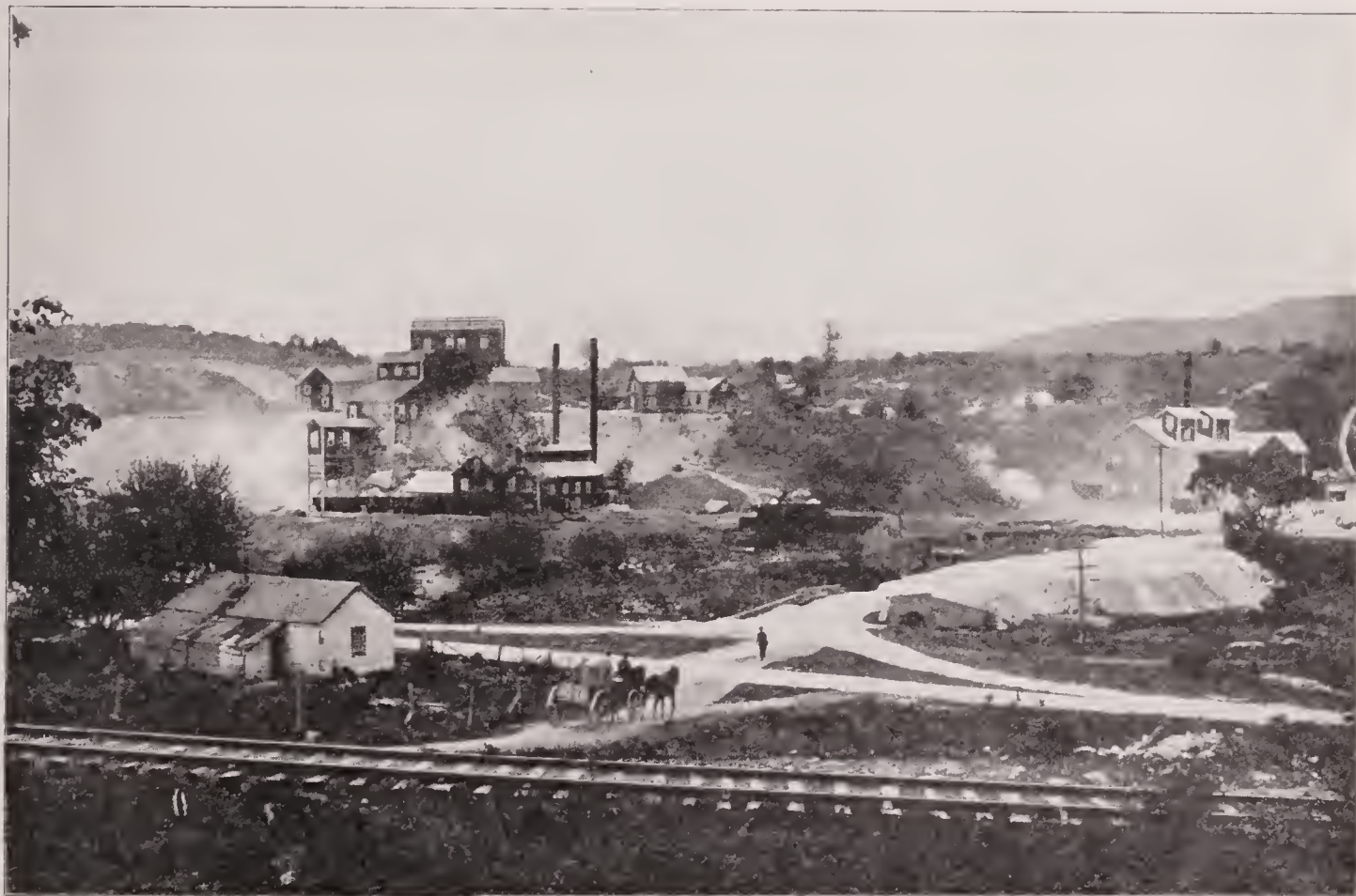
industry has reached large proportions, and in many other states of the union successful mines are in operation, important in their contribution to the local demand.

An important by-product of coal which is utilized in a multitude of ways, is coal tar, now so common that it has largely displaced pine tar. It is produced in the manufacture of gas, and from it we get the material used in every city pavement, as well as creosote, dyes, and various familiar medical remedies, such as acetanilid, etc.

ZINC AND OTHER PRODUCTS OF THE MINES

Among the minerals entering commonly into domestic and industrial uses is zinc, which is produced in certain districts of the United States in large quantities. The State of Missouri is the location of the most important zinc mines of the country, which center about the city of Joplin in the southwestern part of the state. The development of zinc and lead mines within the last few years brought about the increase of the population of the place from 10,000 to 26,000, between 1890 and 1900. The zinc output here annually approaches 150,000 tons, with a value of considerably more than \$3,000,000. Lead mines in the same vicinity yield about half that number of tons with about the same value.

The rapid increase in the demand for electrical appliances of all sorts has increased in like measure the value and the need of zinc which is used so much in electrical mechanics. This has resulted to the profit of the zinc miners, in like degree as the copper interests have profited from the same cause. The enormous copper mines of northern Michigan, Montana and Arizona have multiplied in the value of their output within recent years, thanks to the demands of electricity in its various uses. The annual production of copper in Montana approaches \$30,000,000, and the other producing states named are not far behind. The total annual value of our mineral products equals \$650,000,000.



A ZINC MINING SCENE.



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TYPICAL NEW YORK "SKY-SCRAPERS."

The two great edifices here pictured are the tallest office buildings in the world and of all structures are surpassed only by the Washington Monument, the Eiffel Tower and one or two Cathedral spires.

THE CITY "SKY-SCRAPER"

If our ancestors who died half a century ago could return to the scene of their labors today they would find so many changes in the forms of industrial activity and household life that they would almost think themselves in another world; and if our forefathers of two centuries ago could be given a glimpse of the inventions, the discoveries and the cities of today they would think themselves victims of a delusion. It is related that a trader on one of the western Indian reservations some years ago gained a reputation for untruthfulness among his copper-colored neighbors by telling them of city buildings, which he had to call wigwams for their understanding, which he said extended four and six and eight stories into the air. After some years he was required to bring the chief of the tribe to Washington for some purpose, and when they returned from the journey the red man verified his white brother's stories, and went farther, because in the meantime buildings had reached the height of ten and twelve stories or more. For years he stoutly maintained the truth of his statement, against all the doubts of the tribe, until finally, as his memory began to fail, he admitted that he must have been mistaken, that his eyes had deceived him, that he had been confused by the journey and the crowds, and that after all it was unreasonable to suppose that men could live in wigwams piled to such a height.

The wonder of such an aboriginal traveler could not be greater than that of one of our own mediaeval ancestors who might return. Nowadays the streets of our great cities are marked by commercial and office

buildings many times as tall as the tallest factory chimney a few years ago. The "sky-scraper" has its distinct place in modern city building, and its name is happily descriptive of its characteristics. The phrase-makers have been busy with this modern giant. The inhabitants of the tallest buildings are popularly known as the cliff-dwellers. One apt critic has likened the narrow streets thus overhung to the canyons of western rivers, worn by erosion through the ages, to a level far below the natural surface of the country. In this comparison the busy traffic upon the streets below becomes the eroding stream, and the walls of brick and stone the rough sides of the canyon.

Leaving these apt comparisons for the more practical, we find that apparently there is yet no limit to the height of the city sky-scrapers. Chicago was the pioneer in their construction, and today some of Chicago's streets are almost lined with splendid structures of this type. But New York has outstripped Chicago, while every large city from the Atlantic to the Pacific has its quota of these architectural innovations, and they are no longer a novelty.

It is hardly more than fifteen years since the first sky-scrapers, the Montauk, the Tacoma, and the Owings buildings, were erected in Chicago, and now their twelve-story limit seems low indeed in comparison with the multitude that have succeeded them. When they were begun no one prophesied that others more than twice their height would follow within ten years. And yet they were a result of conditions that have been forming for many years.



THE MASONIC TEMPLE, CHICAGO.

Building methods had become improved and simpler, and land values had risen with great rapidity. Space in the business centers of the great cities became more and more desirable, and the passenger elevator, which enabled offices in high buildings to be reached with ease, had been perfected. So architects and engineers began to study the situation, and they developed what has since become known as the "Chicago construction." This means a method of building by which the walls of masonry are only a veneer for beauty and protection, but the strength of the structure itself is in the steel

framework, braced and bolted together until it stands like a skeleton, clad only on the surface with the brick or stone facing for its flesh. Such a framework, properly built, can no more be shaken down by an earthquake than can a birdcage. And the masonry itself, supported independently by the steel beams of each floor, is not required to maintain its own weight from the bottom. This is a great economy of light and space, to mention only one detail. Under former methods the walls had to be thicker at the bottom, the taller the building was to be. And for a very high structure such walls



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"NEWSPAPER ROW," NEW YORK CITY.

The domed building at the left is that of the New York World. The one in the center, with the spire, is the Tribune building. Between them, the little old-fashioned structure is the office of the Sun. At the right of the picture is the Times building.

encroached materially on the ground area, while the thick walls cut off a great deal of the light from the windows. As it is now, the walls at the first floor of a modern sky-scraper are hardly thicker than they are for an ordinary residence of masonry construction.

But the problems of such a building are not all above the surface. The enormous weight of the structure must be supported from below, and increased strength for the foundation was a requisite. The soil must be studied and the best methods devised to prevent the building from settling irregularly, so that altogether this branch of building has become almost a department of civil engineering. In New York, where bedrock underlies the surface at a depth not too great for building purposes, the foundation begins with a forest of piles, sometimes hundreds of them, thirty or forty feet long, driven down into the ground with hundred-ton hammers. These are placed so that they will be directly under the great vertical columns upon which the completed building will rest. Over the tops of these piles a layer of concrete is formed, with steel rails embedded in it. When this is hardened the mass of steel and rock thus created is virtually impregnable. Next above this subfoundation come huge blocks of granite and the brick piers of the building, upon which rest huge steel beams, distributing the weight equally to every part of the foundation. From this surface the superstructure of the building itself rises.

In Chicago conditions are different. The entire city is virtually floating on a layer of clay which underlies the surface soil and sand, and below this clay layer the substance is soft and yielding, so that it does not suffice to puncture the clay with piling.

As a substitute, therefore, a more expeditious and economical method is in use, which serves equally well. Wherever one of the principal upright pillars is to be set up the builders lay a pad of steel and cement of such extent that the pads for all pillars cover all the site. These pads are slightly pyramidal in shape, and are made by laying alternate courses of steel beams, crosswise, one upon the other. Each layer of crossbeams of steel is filled in and solidified with cement, and then the next two courses are added and similarly treated. At last each pad is eighteen inches or more thick, and perhaps eighteen feet square, but the size is governed by the desire to distribute the weight of the building at about an average of a ton to the square foot. The famous Rookery building, set up on these steel and cement pads, did not sink quite an inch, though the architect's calculation was that by squeezing the water out of the clay underneath it would settle seven inches.

From the surface upward there is no difference in the construction of the skyscraper in Chicago and other cities. The enormous steel girders that make up the frame are all braced and riveted together in every available place. Brick, stone or terracotta is used for the surfacing of the walls. The floors and the inner walls are made entirely of hollow, fireproof brick, and the plaster is laid upon laths of thin steel, so that a fire may consume everything in one room and yet not spread to another.

One of these great buildings is a very city in miniature, with elevators divided into express and local service, with restaurants, barber shops, telephone exchanges and telegraph offices, special fire department and postoffice, detectives, its own electric



PHILADELPHIA SKY-SCRAPERS AT BROAD AND CHESTNUT STREETS.

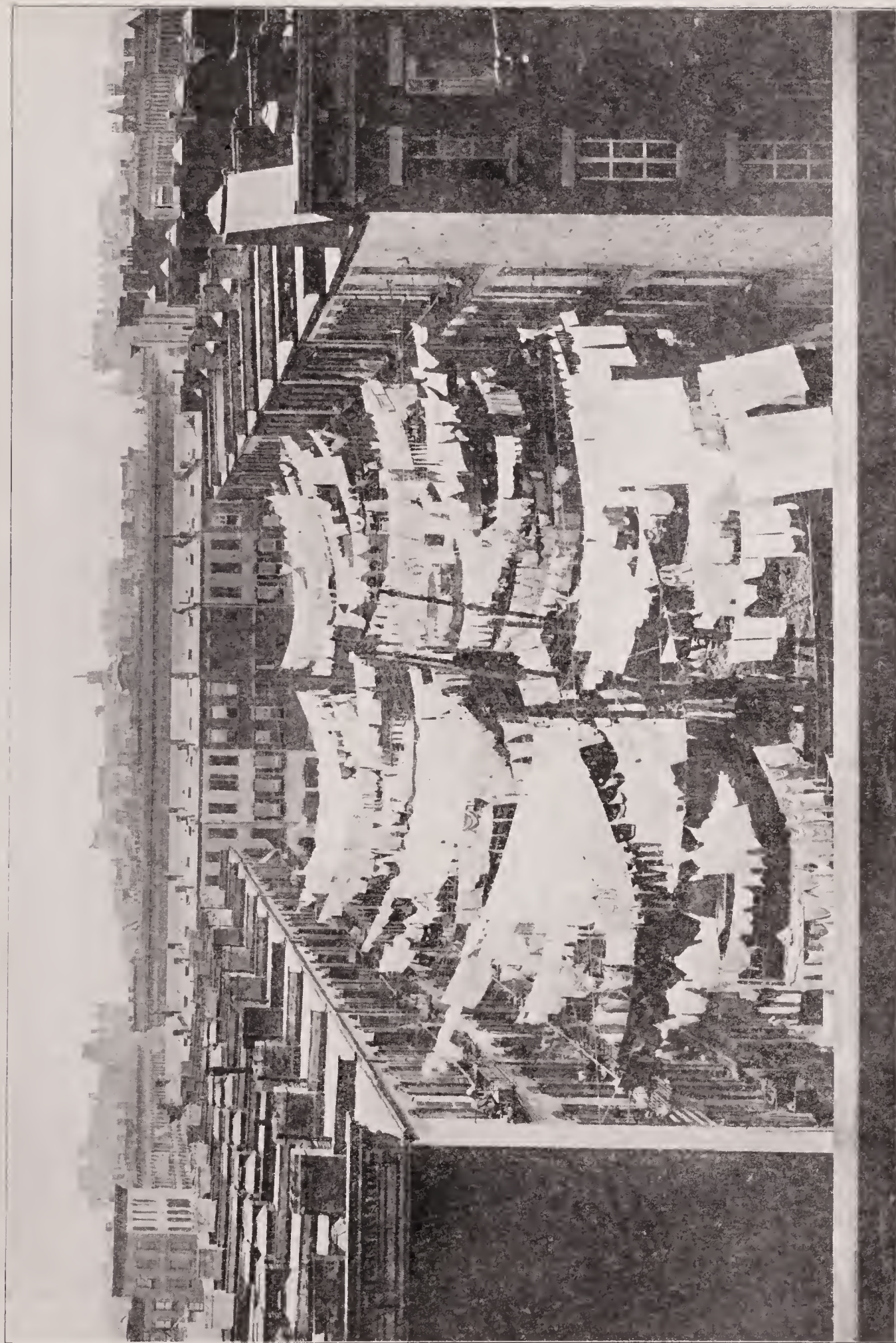
light and power plant, and a population from 2,000 to 5,000. In such a building the varied industries directed and represented conduct a volume of business greater than that of many a town of 20,000 inhabitants.

The tallest buildings yet erected are in New York, where two or three reach a height of twenty-nine stories, and measure approximately one-tenth of a mile from the tip of the flag pole to the bottom of the foundation. The weight of such a building is about 20,000 tons, and this may be doubled or tripled when its tenants, their furniture and their stocks of goods are included. In the accompanying picture from New York two of these giants are shown towering above other buildings which are themselves large structures.

In Chicago, which was the pioneer in sky-scraper construction, no entire building is more than twenty-one stories, though the tower of one great commercial edifice on the Lake Front exceeds this height. The Masonic Temple, for many years the king of all the giants, although now surpassed in altitude, is some 330 feet in height. The upper story has been turned into a great



"BARGAIN DAY" ON A SHOPPING STREET.



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"BLUE MONDAY" IN THE CITY—WASHDAY IN A CROWDED BLOCK.

summer theater, 300 feet above the ground, and still above this is the observation promenade on the roof itself.

The picture of New York in a "blizzard" is a suggestive indication of what happens in a great city when a winter storm sweeps down between the sky-scrapers. Under such circumstances all the municipal forces are enlisted to clear away the drifts as soon as the storm ceases, in order to reopen the way for the interrupted traffic. Such terrible storms are not of annual occurrence, but when they do come the suffering is great. It is difficult for those who have not experienced it to realize how quickly the

food supplies of a great city become exhausted when traffic ceases and shipments from the country are no longer possible. The amount of fresh meat, vegetables, eggs and dairy products necessary to supply a metropolis of 2,000,000 or 3,000,000 people is enormous, and when once the source is cut off, suffering soon follows discomfort.

No one knows what the limit of sky-scrapers may be in the future. Some cities have enacted laws regulating their height, only to repeal them as unnecessary restrictions after a short period of halt in important building operations. It has been argued that they are subject to great dan-



A TYPICAL CROWD ON STATE STREET, CHICAGO.

ger from the weakening of their steel supports by the process of rust, and that though fireproof themselves, they may be threatened with great danger from fires in adjoining buildings. The most expert fire-fighters and the insurance companies agree, however, that they are as safe as any structures and that fires can be extinguished in them as readily as elsewhere. The presumption is, therefore, that unless the congestion of business in the heart of a great city is relieved by changing conditions, not now apparent, we have not yet seen the height limit of these twentieth century giants.



GREAT OFFICES FOR GREAT BUSINESSES

One of the most picturesque features of the industrial and commercial institutions which have been forming, by consolidation and otherwise, within the last few years, is the astonishing perfection and magnitude of their business administration and office organization. The day is past when the individual owner or chief officer of a large business could himself observe its details and maintain direct control over its administration. Now it has become a matter of office machinery, of high organization, of department managers, of selected trustworthy men, to whom various subdivisions of the work may be entrusted, and who will themselves guard faithfully the interests of the great impersonal corporations which they serve.

The greatest weakness found in these immense corporations is in their possible failure to enlist the personal loyalty of their employees. If they fail in this, the highest executive ability cannot maintain their per-

manent prosperity against the movement toward individual business independence.

Andrew Carnegie, the great ironmaster whose benefactions to the cause of learning have made him conspicuous in directions outside of his industrial undertakings, declared in an estimate of himself that he had prospered largely because he had the discernment to surround himself with loyal employees who knew more than he did. Whether Mr. Carnegie intended this lightly or not, the merit of the expression can not be denied. The ability, the strength and the time of one man, however brilliant, could not be expanded to encompass the manifold obligations of the enormous commercial and financial and industrial undertakings of to-day.

An accompanying illustration shows the interior of the largest office in the world, the business office of one of the great packing-houses at the Chicago Stock Yards, whose operations are described elsewhere in this volume. This illustration, made from a photograph, indicates more clearly than words can do, the size of such a business concern. No argument is needed to suggest that only by the most perfect organization and subdivision of duties could such a business be carried on without great waste of time, labor and money. Here a thousand clerks, bookkeepers and other employees work in a single immense room, carrying on the business of the plant which operates nearby and deals with the whole world. So it is with great railway consolidations, great banks, wholesale houses and other forms of modern commerce and industry. Those which organize most perfectly to forbid waste and to utilize all their resources and energies are the ones which achieve conspicuous success.



THE LARGEST OFFICE IN THE WORLD.

Business office of Swift & Company at their packing house, Chicago Stock Yards.

PHASES OF STREET LIFE IN A GREAT CITY

Street and household life in a great city has an unfailing interest to the observer, whether he be a student of social conditions or merely a seeker for entertaining novelty. Street crowds in a metropolis on the most ordinary shopping days are so great as to suggest a holiday or a parade to the stranger from a smaller town. And yet the flow of the stream of humanity is unceasing, and the procession of wheeled vehicles is never interrupted, except at the street crossings, where pedestrians and drivers are alternately given the right of way at the behest of the vigilant policeman. To thread one's way through such a crowd in the heart of the city becomes almost a sixth sense, and while the unaccustomed stranger may be bewildered by the roar and the confusion of traffic over the noisy pavements, and the multitudes which jostle him at every step, so that his progress is halting and slow, the resident passes from street to street or office to store, almost without noticing these things which are so familiar to him, and, reaching his destination without delay, does not realize the crush through which he has passed. Upon the shopping streets of the great city the big stores display their wares in glittering array in decorated windows, or heap them enticingly upon racks at the edge of the sidewalk itself. Not the least pleasure of a stroll down a shopping street is found in the study of these window and sidewalk exhibits. Beautiful fabrics, millinery, books, china, jewelry, furs, pictures, furniture and the other offerings of the merchants are arranged to the best advantage to attract the unwary, and such a street in a metropolis today is hardly second to a

great international exposition, so carefully selected are the goods and from such widely diverse markets of the world do they come.

Once out of the business district of the city, and passing through the more crowded residence portions, another evidence of the multitudes who dwell in such a center of population may be seen. "Blue Monday" is just as regular in its arrival in the city of a million as it is in the small village, and the freshly washed garments of the household need sun and air for drying in like manner. Without beautiful lawns and ample grounds around them as have the more favored quarters in the less crowded communities, the people of the tenements must utilize what facilities they have. The essential and practical clothesline is made the subject of household ingenuity. The narrow back yards between the tenements are criss-crossed with an apparent tangle of lines, some high in the air and stretched to telegraph poles, or from house to house between fourth-story windows. The glimpse of such an area thus decorated, on a city washday when the sky is clear and the bright sun has encouraged the outdoor drying of the fresh linen, is peculiarly novel, and suggests forcibly the crowded fashion in which people in the city must live.

The immigrants who come to America generally choose to settle in communities in the cities, forming streets and even whole districts of their own nationalities. In New York and Chicago Russian, Jewish, Polish, Italian, Chinese and other special quarters have been established, where they preserve their European customs and afford interesting street sights for strangers.



NEW YORK IN A BLIZZARD.

(A scene on Broadway, with city traffic blocked during the continuance of the storm.)



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STREET SCENE IN THE JEWISH QUARTER OF NEW YORK CITY ON A BUSY MARKET DAY.

THE CHICAGO STOCK YARDS

THE WORLD'S MEAT-MARKET

The world's meat-market is at Chicago. Great as are the stock yards of Kansas City, Omaha, and other western cities where the cattle industries center, Chicago stands far at the head of the list in magnitude of the business transacted. The Union Stock Yards are five-and-one-half miles from the heart of the city, conveniently located to the railway lines which bring the cattle trains from the western ranges. The yards are a virtual city in themselves, comprising nearly 500 acres, of which 320 acres are covered with plank flooring. There are 25 miles of streets and alleys between the pens, 38 miles of water troughs, 50 miles of feed-

ing troughs, and 105 miles of water, sewer and drainage pipes. The plant cost \$4,000,000, and twenty trunk-line railways roll their cars upon the network of tracks by which the yard is served. Six artesian wells furnish the water supply and in the summer the tanks and reservoirs hold water for emergencies to the amount of 8,000,000 gallons.

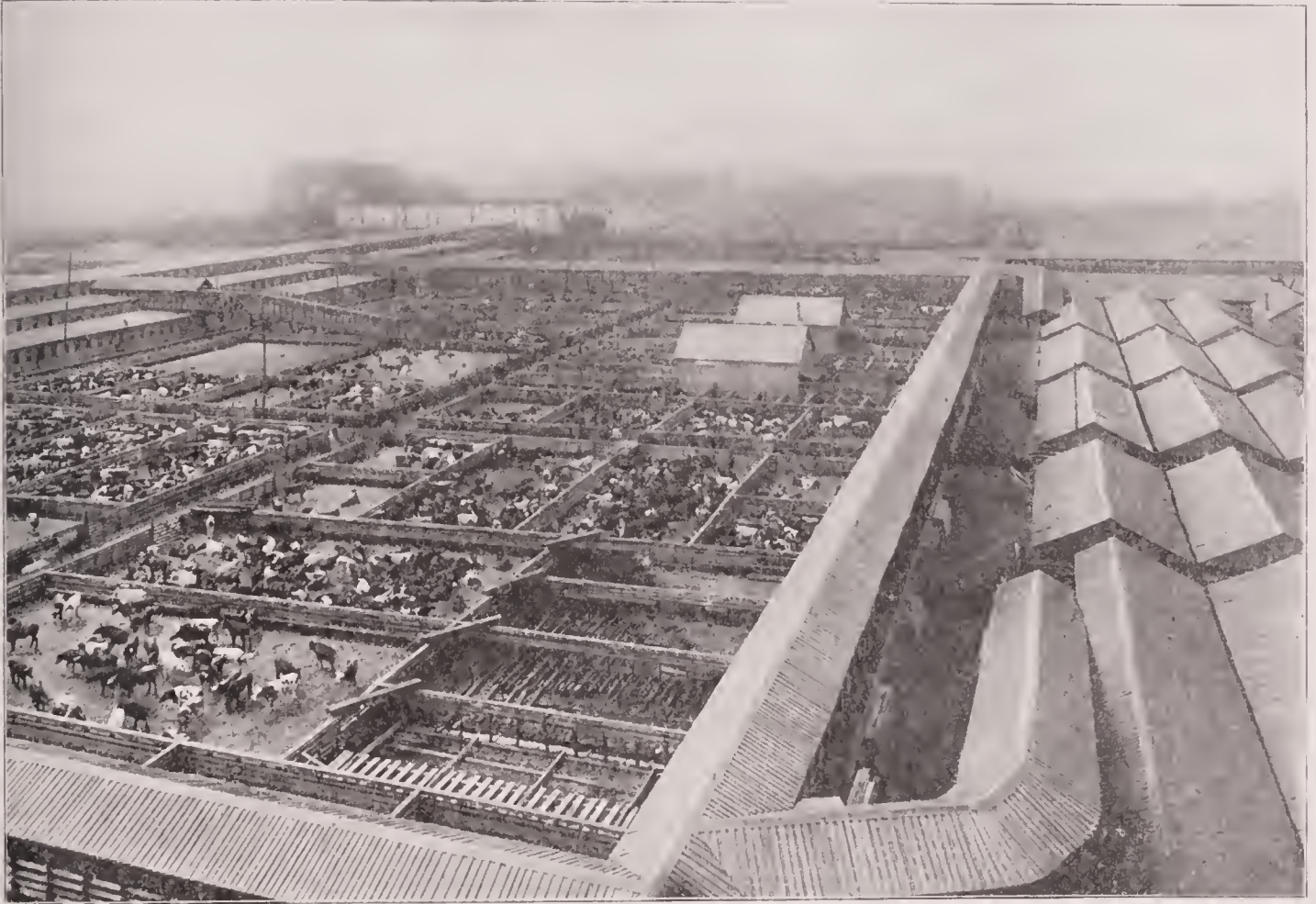
This is the greatest cattle, hog, sheep and horse market in the world. The annual receipts of animals are approximately as follows: 2,500,000 cattle; 150,000 calves; 9,250,000 hogs; 3,750,000 sheep, and 125,000 horses. To bring this stock to market



PACKING HOUSE FEEDING PENS, CHICAGO STOCK YARDS.

requires nearly 300,000 cars, which would make a train almost long enough to reach clear across the continent from New York to San Francisco. The pens when filled will hold 15,000 sheep, 20,000 cattle, and 120,000 hogs. There are 13,000 of the pens altogether, of which 8,500 are roofed for hogs and sheep. The pens for hogs are two-storied or "double-decked."

afternoon there is another rush when the cars of the eastern lines are laden with the outbound shipments of dressed and canned meats for the eastern markets and for export. The Stock Yards Company owns the railroad tracks and charges toll for them. When a load of stock is placed on a side track, the cattle or hogs are driven into the pens assigned them, to await the



AMONG THE CATTLE PENS, CHICAGO STOCK YARDS.
Showing one of the great packing houses in the background.

During the early morning hours, the scene at the Stock Yards is a busy one. Between 4:30 and 9 o'clock, nearly 35,000 persons enter the gates for their employment in the yards proper, the packing-houses, and the connected industries. The forenoon, which is the time of unloading the cattle, sheep and hogs from the western railways, is a busy period, and during the

call of the commission men to whom they are consigned. The sales go on all day long, and are marked by methods that have been gradually simplified to a most extraordinary degree. From the chutes the animals are driven to pens that custom has given to each particular firm. Here they are inspected and sold. Government inspectors throw out poor stock, while the

public "shrinker" docks some animals that are not in the best condition from forty to eighty pounds. Condemned animals have a tag fastened in their ears. In an incredibly short time the buyers have rejected what animals they do not want, have inspected others, have seen the herds weighed like magic upon patent live-stock scales, and have had a scale or weight ticket issued

and everything else necessary for the convenience of shippers and buyers. All kinds of feed are delivered to the pens by the company, and the watering, feeding and herding are conducted under the direction of the company at fixed rates of payment. Two hundred commission firms, with representatives and offices in the yards, are on hand to receive shipments on consignment



GOVERNMENT INSPECTORS AT WORK IN THE STOCK YARDS.

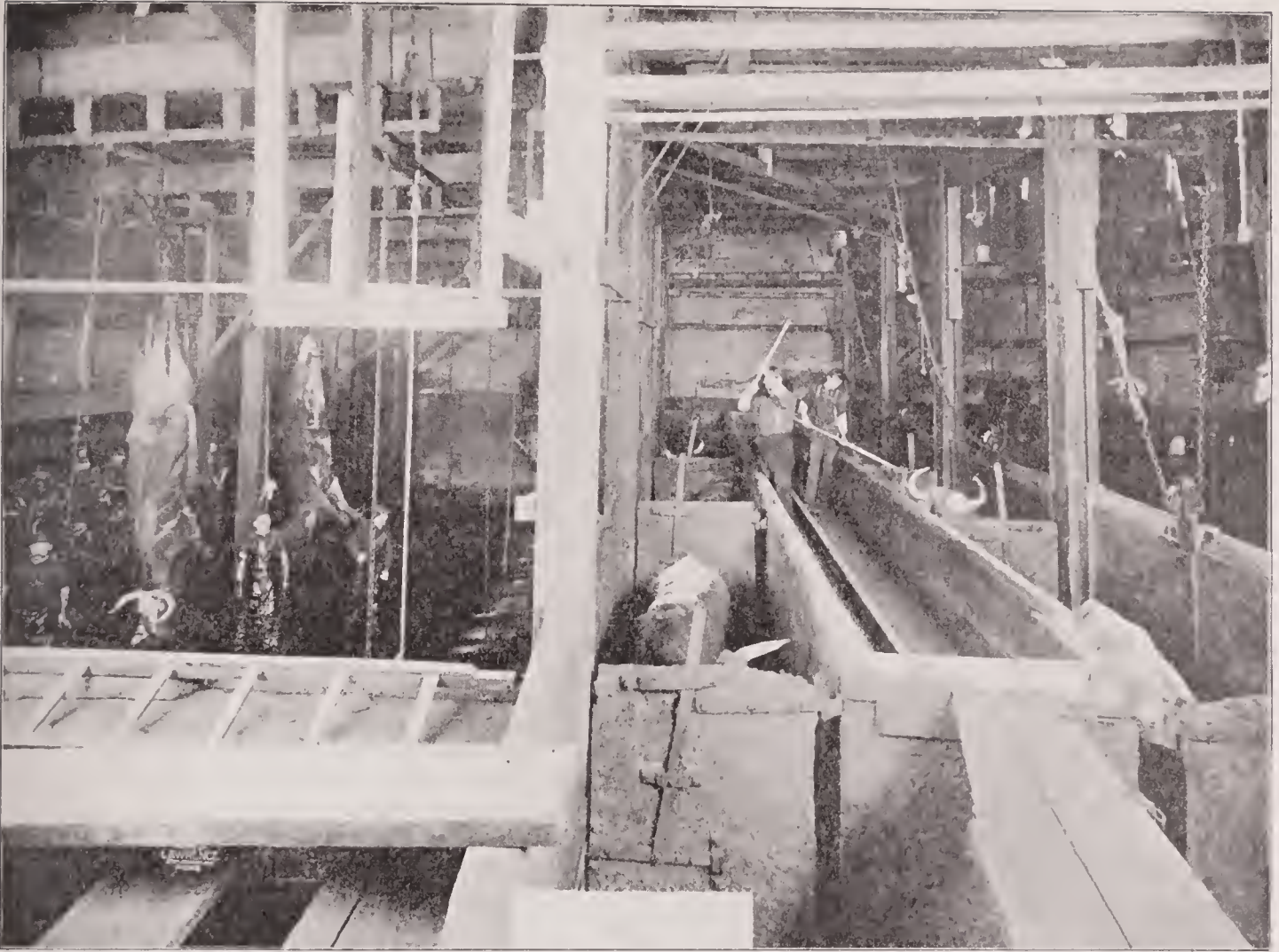
by the Stock Yards Company, to be presented for payment as if it were a formal bill. By an arrangement with the bank, these tickets are in a simple manner made to serve as checks.

The Stock Yards Company has organized and controls all sorts of industries within its property, including water works, fire department, hotel and restaurants, bank,

and protect the interest of the stock raiser at stipulated commission fees. A thorough inspection under government supervision protects the public against danger from diseased stock. In view of the magnitude of our American stock interests, and our national struggle to preserve the standing of American pork in the markets of Europe, these great Stock Yards become interesting to the whole world.

Hardly any product of American conditions more thoroughly typifies our national enterprise and ingenuity.

From the ranges of Texas, New Mexico, Montana and Wyoming, from the broad fields of Dakota, Kansas and Nebraska, from the Mississippi Valley immediately tributary to the great metropolis, come the hundreds of thousands of fat cattle, sheep and hogs for distribution to the markets of the world. Hardly any rival of consequence in beef production exists in the world, outside of



CATTLE KILLING IN A GREAT PACKING HOUSE.

North America, except the Argentine Republic, where a large cattle industry has been built up in the last twenty-five years. Australia and New Zealand are strong in the European markets with their dressed mutton. But the animal products of our own great west never lack purchasers and to the perfect system developed at such yards as these of Chicago and the others in neighboring cities, only second to them, must be credited a large share in the rapid growth of the industry.



GREAT PACKING-HOUSES OF CHICAGO

There is a familiar jest in circulation in the great packing-houses which have been

developed as adjuncts to the Stock Yards of Chicago, that everything is saved of the slaughtered animals except the squeal of the pigs. So complete is the utilization of every shred of what in a less perfect organization might be called waste, that the ancient jest becomes almost literally true. It is to this fact that in large degree is attributed the rapid upbuilding of the immense establishments, and the steady growth of great fortunes for their owners. The value of the by-products saved from the refuse in a single large packing-house in the course of the year, itself measures almost a fortune, and establishes the difference between profit and loss.

Let us follow the processes of a typical

packing-house from the beginning to the end. Buyers employed for the purpose, purchase such cattle as are wanted for the day, which are driven from the buying-pens over long runways, to pens near the slaughter houses. From these pens an inclined, enclosed gangway leads into the slaughter house itself, where the animals are to be turned into butchers' meat. Some

pens within the house, which are only as large as small stalls, with room for one animal in each. Men run along narrow platforms just above these pens, and with small sledge hammers strike the cattle upon the head, just between the horns. Then the doors of the pen are thrown open, chains are fastened about the hind legs of the unconscious beasts, and they are swung



By permission of Swift & Company.

THE BEEF REFRIGERATING ROOM OF A GREAT PACKING HOUSE.

of the packing-houses have fat and comfortable steers trained to lead the other cattle to the foot of the gangway, there to turn and leave them, while the victims go on to meet their fate. At least one of these bovine traitors to his kind met his just deserts not long ago, and getting into the killing-pen by mistake, was slaughtered before he was recognized.

The inclined gangways lead into small

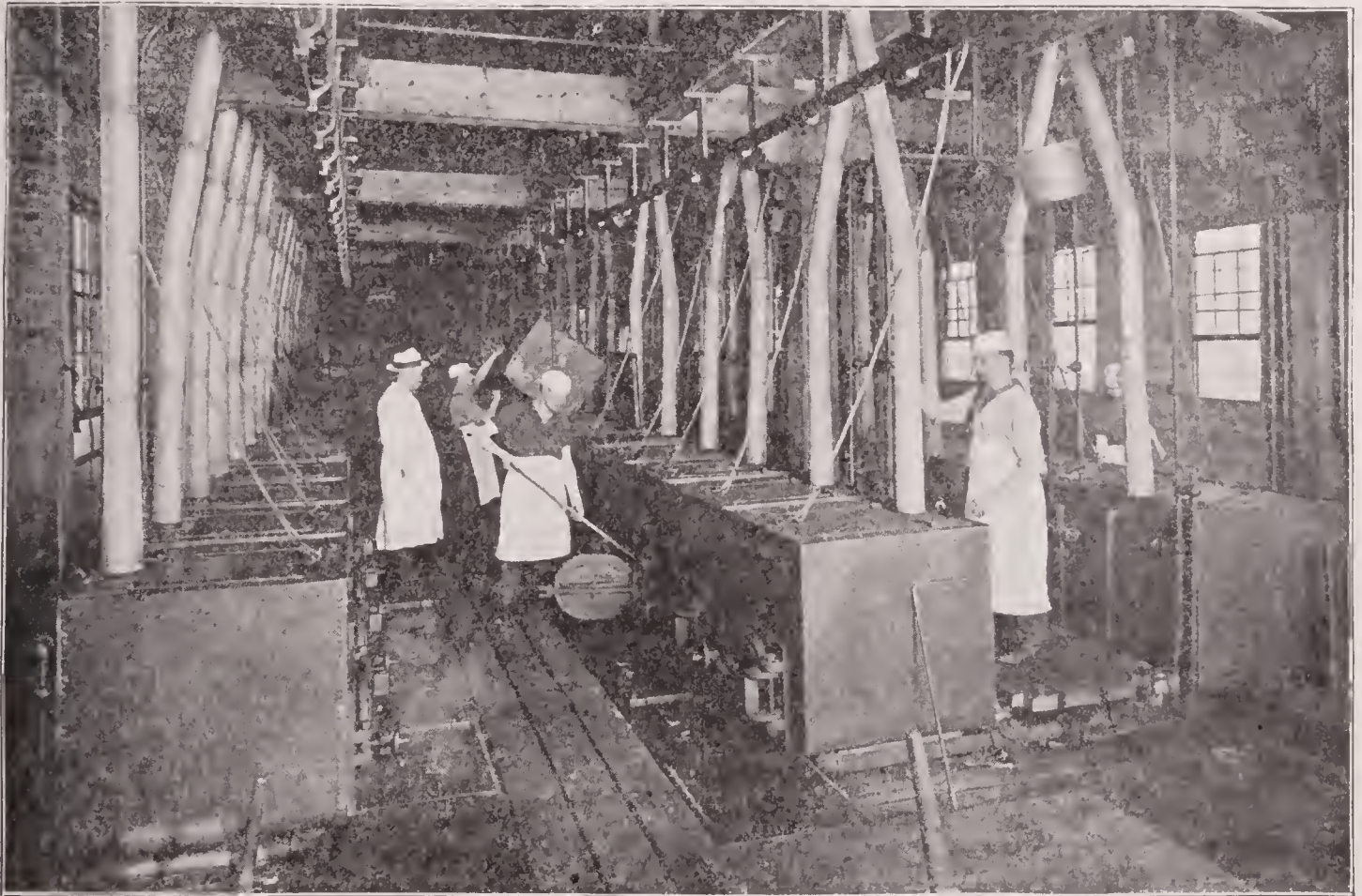
up so that they hang upon a trolley, running on a single overhead rail. Silently and methodically the slaughterers walk along, each performing one detail of the process. The throats of the cattle are cut, and the heads removed. The animal is drained of blood, and then in quick stages the hides, hoofs, shanks and entrails are removed, the carcass is split down the back bone, and traveling along on the endless

trolley, it is washed and stored in great refrigerating rooms for later disposition.

Some of the beef comes out later wrapped in cloth, to be shipped away in specially prepared refrigerating cars all over the United States, or in vessels to Europe. Some of it, of course, goes through various processes of canning and the preparation of delicacies. Every single thing that appertains to a slaughtered beef is sold and put to use. The horns become the horn of commerce; the straight lengths of leg bone go to the cutlery-makers for knife handles; the entrails become sausage-casings; their contents make fertilizing material; the livers, hearts, tongues and tails, and the stomachs that become tripe, all are sold over the butchers' counters of the nation; the knuckle-bones are ground up into meal for various uses; the blood is dried and sold as

a powder for commercial purposes; the bladders are dried and sold to druggists, tobaccoists, and others; the fat goes into oleomargarine, and from the hoofs and feet and other parts come glue and oil and fertilizing ingredients.

Over the slaughter house is a series of rooms heaped full of bones and horns. The bones are boiled to get the fat of the marrow as well as to clean them. Then they are dried and shaken about until they are as smooth and clean as cotton-spools. The knuckle-joints are cut off them, and one room is filled with the ground-up flour of those parts. The white and pretty bones that remain are shipped to Connecticut, England, and Germany, to be worked into knife-handles, fan-handles, tooth-brush handles, backs for nail brushes, sides for pen-knives, and into button-hook handles,



COOKING THE MEAT FOR CANNING PURPOSES.

shirt-studs, cuff-buttons, and so on, ad infinitum. What is to become of the horns is still more astonishing. By heating them and then tapping them skilfully, the operatives loosen the soft cellular filling which solidifies and strengthens each horn. The substance around this, between it and the inner surface of the horn, goes for glue; the rest is ground up into bone-meal. The horns are then sent to makers of horn goods, who, by cutting each horn skilfully and then pressing it between heavy rollers, manage to spread each into a flat ribbon. In this shape it can be used in a thousand ways. The artificers who do this work cut each horn spirally, so that it becomes a tight curl

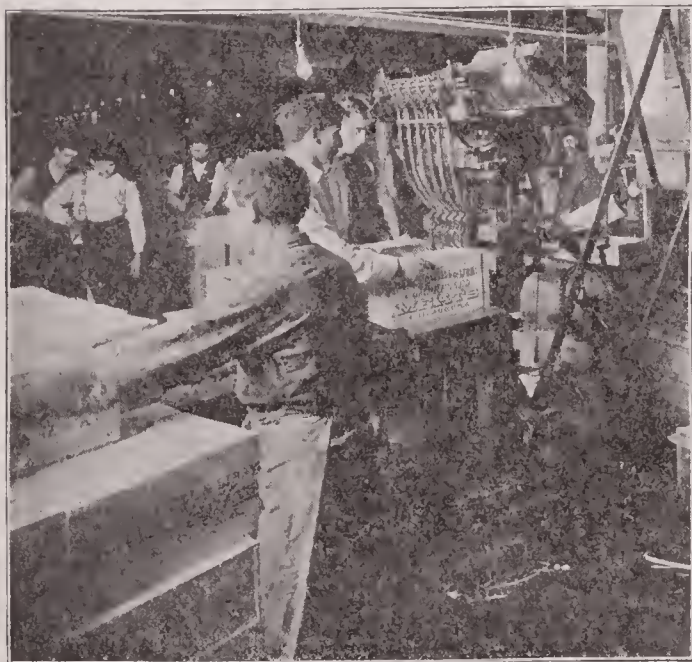


LABELLING THE PRODUCT. SCENE IN THE CANNERY.

capable of being straightened out. By immense pressure the curve is taken out of it. Good horns sell at \$125 a ton. It is by such thorough economy and ingenuity—by losing nothing and wasting nothing—that the great firms in this business have monopolized their field. A small butcher can not kill his meat and market it in competition with the stock yards packers, because he must waste what they save and sell.

The refrigerating and cooling-rooms are kept at a temperature of thirty-six degrees, yet, when the meat fresh from the slaughter is railroaded into such a room, the animal heat in it warms the room for a considerable time, and fills it with steam as with a fog. Once it is cooled, the sides of beef become firm and hard and almost appetizing. Everywhere, except at the actual scene of slaughter, these houses and the work of them are clean and above criticism.

The hog-killing is done in a much more



BOXING MEATS FOR EXPORT.

The nailing machine shown in the cut drives six nails at once.

peculiar manner than the slaughtering of the cattle. In the catching-pen are many hogs. Let us follow one. The catcher snaps a chain around one leg, and hooks the loose end of the chain to the trolley. The hog swings out of the pen to where a butcher stands on a grating. The butcher, with a deft thrust, cuts

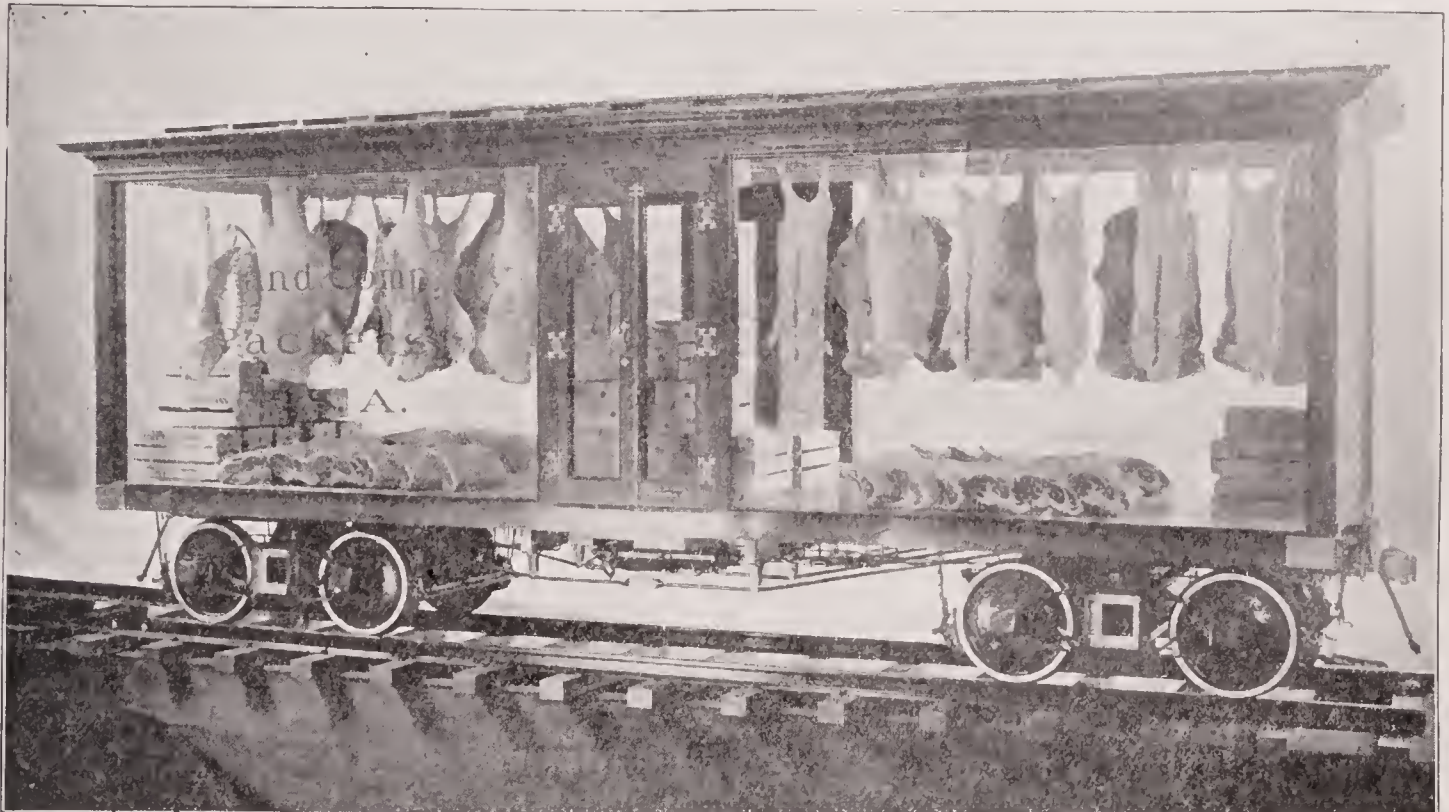
the animal to the heart, and death is practically instantaneous. The dead body swings along to be loosened over a vat of scalding water, into which it is plunged. Other bodies are there, and the water is loosening their bristles. Suddenly a great rake scoops out a hog, and it falls upon a runway, where a chain that is hooked to its



MAKING BUTTERINE.

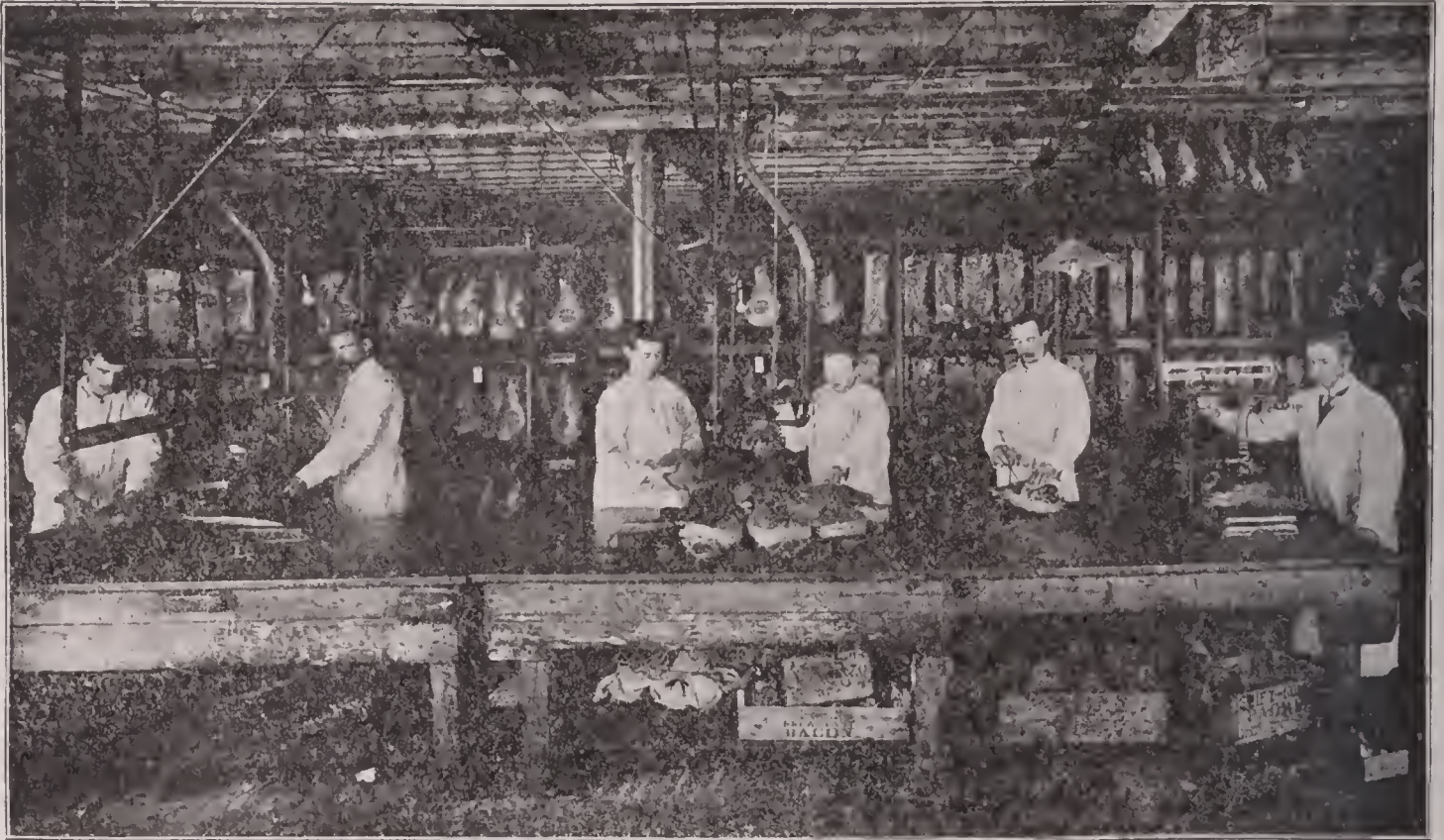
nose pulls it through a steam-scraper. The knives of this machine are set at every angle, and miss no part of the hide on the body.

Once out of the reach of the scraper a number of men pass the body along, and remove every bristle and speck that was missed. Then the body, still traveling



REFRIGERATOR CAR AS PREPARED FOR SHIPMENT.

Through the glass wall of this car constructed for exhibit the exact arrangement of the meats may be seen.



PREPARING HAMS AND BACON FOR MARKET.

along, is washed with a hose and its head is all but cut off. Next it is disemboweled. Then the lard is removed, the head is cut off, the tongue is taken out, and the body is split and passed along to the cooling-rooms. Again everything is saved. The blood is

turned into albumen for photographers' uses, is sold to sugar-refiners, and is turned into fertilizing powder. The bristles go to brush-makers, shoe-makers, and upholsterers. The fat is valuable in many forms, the intestines become sausage-casings, the

livers, lungs, and hearts are minced up into sausage meat, and parts of the meat of the heads made up into head-cheese. The feet are canned or pickled, or worked up in the lard tanks. With sheep the method is similar to the others that have been described, except that they are suspended two by two on hooks that run along a continuous trolley line. As each



PICKING CHICKENS FOR THE CITY MARKET.

pair passes the succession of men in waiting for them, a new step in the process is completed. The killers stick the knives into their throats at the rate of twenty a minute, and the animals continue to pass through the hands of the specialists at that

verily astonishing. One company in a single year has purchased live-stock to the total of 1,437,844 cattle, 2,658,951 sheep and 3,928,659 hogs. Sales the same year amounted to \$150,000,000 and the shipments required 107,684 railway cars. From



Permission of Swift & Company.

DRESSING MUTTON IN A PACKING HOUSE.

rate of speed, until the carcass appears at the end of the trolley, spread apart with wooden braces, and ready for the refrigerating room.

The figures of a single year's business of one of these greatest packing-houses are

this number of live-stock, the packing-house produced in addition to the meat, 196,244,588 pounds of lard; 6,472,857 pounds of wool; 3,888,983 pounds of neatsfoot oil; 5,487,540 pounds of glue; 8,116,338 pounds of butterine; 26,009,453 pounds of

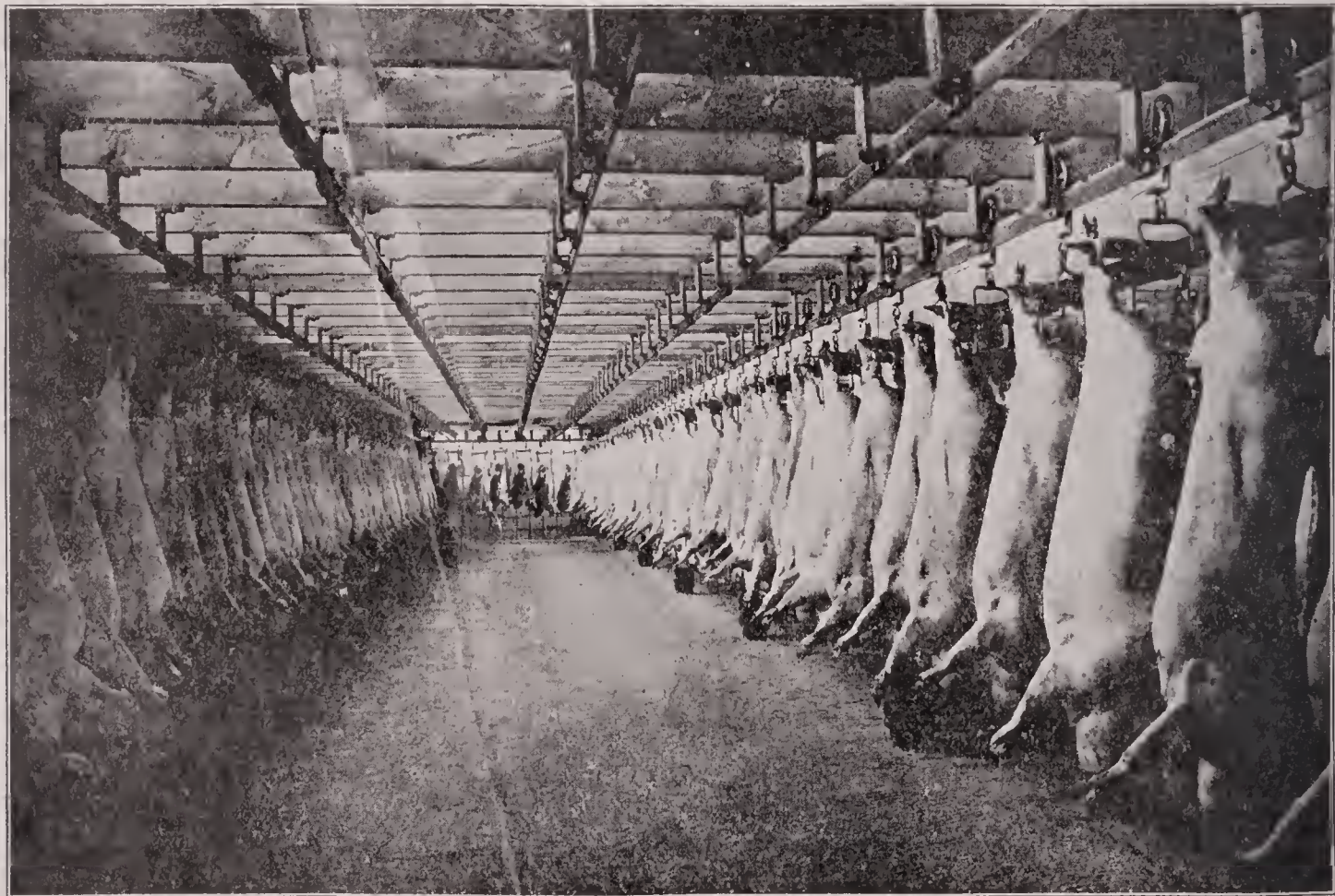


PACKING SAUER KRAUT.

tallow and grease; 61,635,047 pounds of oil; 90,079,748 pounds of hides, and 86,226,586 pounds of fertilizer. To carry on these operations this company has at the Chicago Stock Yards a plant covering forty acres of land, all but two acres of which are under roof, and the buildings have a

floor space of sixty-seven acres. In the refrigerating rooms 125 miles of pipe have a capacity of cooling 1,400 tons of meat daily. The storage and cooling-rooms have a capacity of 5,000 cattle, 7,500 sheep and 12,000 hogs. The payroll of the 7,000 employees connected with this business amounts to more than \$10,000 a day, or nearly \$4,000,000 a year.

The markets for the products of these American packing-houses, of which those of Chicago are but the largest of many such to be found in other western cities, are found the world over. It would be hard for any European power to go to war successfully without patronizing the American packing-houses for their meats and supplies. Chicago canned and preserved meats, and Chicago fresh meats, are found on the



Permission of Swift & Company.

DRESSED HOGS IN THE COOLING-ROOM.

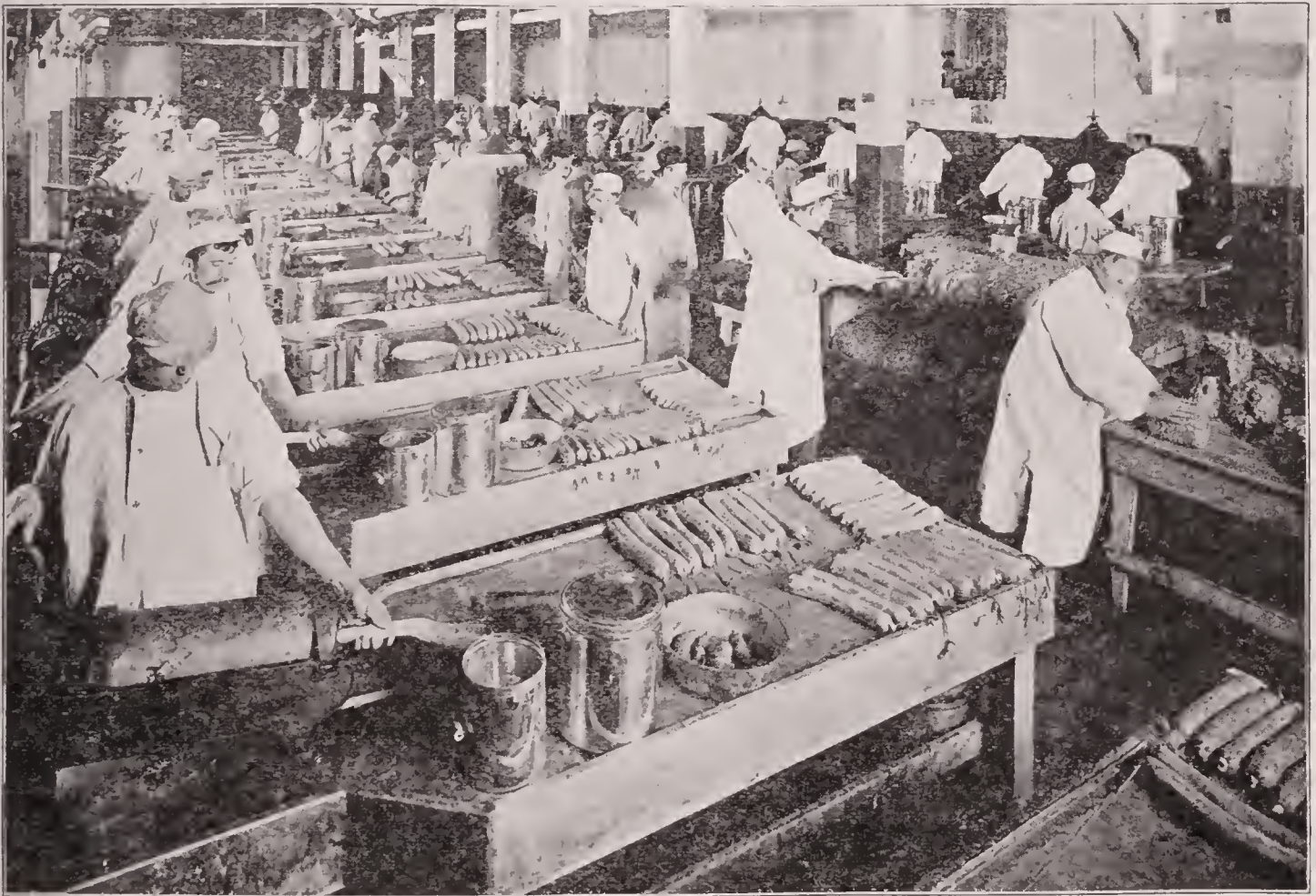
tables of epicures wherever one travels, and the names of the largest houses are known as familiarly in European markets as they are in America. No industry of our country extends its business through more diverse channels or to more remote regions than does this great enterprise.



HOW A GREAT CITY IS FED

The processes by which a great city is fed are simple enough in their details, but of enormous magnitude in their entirety. Before the meats, the vegetables, the manufactured supplies, the poultry and dairy products, the fish, and all the other articles which help to make up the bill of fare of the modern household are gathered together in a single retail market for neighborhood

supply, a very large part of the industrial activity of the world has to be levied upon to assist. The meats have come from the cattle ranges of the southwestern and northwestern states of our own country. According to season, fruits and vegetables may have come from Southern California, the Gulf of Mexico, the West Indies or our own immediate neighborhood. Whole train loads of milk come into the cities every morning from the dairy regions round about. Imported food supplies, such as spices, tea, coffee, chocolate and the multitude of other delicacies, are brought from all over the world. Fishermen are dropping their nets in the Mediterranean, or off the Grand Banks of Newfoundland, or in Lake Superior, or in the North Pacific to supply us with sardines or mackerel or



MAKING SAUSAGES.

white fish or salmon. Ships are crossing every sea, and railway trains are speeding all over the continent, collecting and distributing the food for the cities' needs. And so it is that in the last analysis the greatest part of the industrial energy of the world is employed directly or indirectly in providing food for mankind. Of course it is in the cities, where population is congested and food production virtually absent, that the commercial side of this industry becomes most conspicuous and interesting to the stranger. Everything must be done on a large scale. If the city be an ocean port,

its docks are lined with vessels from all over the world, bringing the foreign products demanded for local consumption and for distribution throughout the country. If it be a lake port in the shipping season, the cargoes of fruit and vegetables from the adjacent regions, where such things are produced for market, are unloaded in an endless stream of enticing viands ready for the day's needs. The railways contribute their own quota to the current demand and the long trains of freight cars rolling in by every converging line, continually replenish



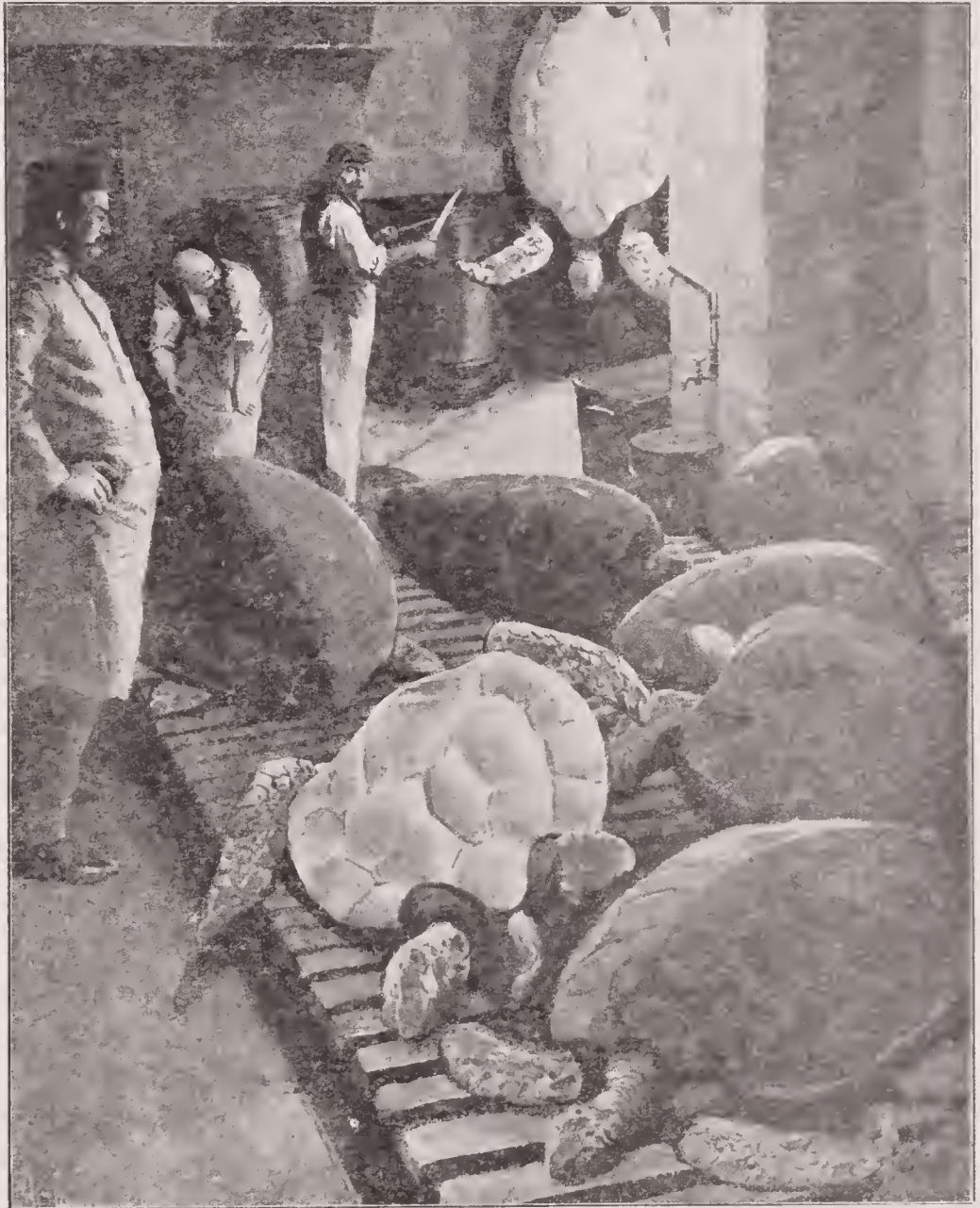
SOUTH WATER STREET, CHICAGO.

the exhausted markets, day after day.

Perhaps the most striking feature of the whole process of feeding a great city may be seen in one of the market streets of a metropolis, where wholesale dealers distribute the supplies which they receive from country shippers, to the retail grocers and meat and vegetable market men throughout the city. A noteworthy example of this sort is South Water Street in Chicago, known to almost every traveler and famous far and wide. This street lies parallel with the Chicago River itself and immediately adjacent to it, so that the vessels bringing vegetables and fruits from across the lake are able to discharge cargoes to the best advantage. On both sides of the street, for nearly half a mile, wholesale houses and commission houses dealing in fruits, poultry, game, eggs, butter and cheese, and all kindred market wares, elbow each other. The street itself is jammed with delivery wagons, one row backed up against the sidewalk on either side and two processions keeping to the right and passing each other all day, from before sunrise to dusk at night. The sidewalks themselves are exceedingly crowded with the great crates and

boxes which have overflowed from within the stores.

Here are dealers who purchase vegetable and fruit crops from all over the United States. Some of them have scores of buyers, who visit farmers throughout the coun-



PREPARING TURTLES FOR SOUP.

try, contracting for their fruit and vegetables. Other dealers specialize upon tropical products, and the banana trade, which is largely in the hands of Italians, has risen to enormous portions. Saturday is the busiest of all times on "the street."

as it is familiarly termed, because it is then that the whole city is buying its Sunday dinner, with all the care which such an important undertaking requires. The large hotels and boarding houses sometimes send directly to this wholesale market for their supplies, with the conviction that it will profit them to do so. The average householder, however, depends upon his neighborhood market, instead of these wholesale houses. It is fortunate that it is so, for with South Water Street already as crowded as it is, there would not be standing room if the number of patrons were to be doubled.



TAPIOCA AND CASSAVA FROM THE MANIOC

The manioc is a shrub that grows six or eight feet high, having a tuberous root weighing about thirty pounds. Associated with this mass of starch is a poisonous, milky juice of hydrocyanic acid. Being

very volatile, this acid escapes in drying or baking. The root is scraped into a pulp and the juice pressed out. The pulp is baked and then called cassava bread. The juice is left standing for several days, when a fine starch is precipitated, which is known in commerce as tapioca. When the deadly hydrocyanic acid is boiled out of the juice, there remains the sauce known as casareep. When fermented with molasses the casareep forms an intoxicating beverage known as ouycou.

The starch of manioc is exported from Brazil under the name Brazilian arrow root. The manioc is propagated by cuttings from the stem, it grows rapidly and its annual production per acre is six times that of wheat. In the West Indies and South and Central America, the cassava bread is a favorite food. Tapioca is a delicacy appreciated for our own tables. The cultivation of the plant is a considerable industry in Florida, where it proves highly profitable as a forage for cattle.



FIELD OF CASSAVA IN FLORIDA.



THE SMITHFIELD MEAT MARKET, LONDON. THREE-AND-A-HALF ACRES UNDER ONE ROOF.



LUMBERMEN BOATING DOWN A MOUNTAINSIDE.

In British Columbia flumes are used to float logs from mountain tops to saw-mills. The men nail boards together and come down the same way, traveling sometimes a mile a minute.

LUMBERING IN AMERICAN FORESTS

The forests of the world have been the source of shelter and prosperity for countless millions, but never have they entered more fully into the industrial life of the people than they do to-day. In America alone the lumbering industry, with its branches, is recognized as one of the most important factors in our national prosperity. The forests began to serve us long before we were born, for to the trees before the coal age we owe the enormous deposits of fuel which we are even now digging from the mines, for use in great manufacturing enterprises, in our railway locomotives, and in our households.

But timber in its natural form is a source of wealth to any wooded country. It is an evidence of the increasing intelligence of mankind in this industrial age, that all the world over, influences are at work to promote the preservation of the forests and to put an end to wasteful extravagance in their destruction. Estimates have it that the forests of the world cover 1,201,000,000 acres of land. Russia leads the list with 485,000,000 acres, the United States comes second with 176,000,000 acres; Canada third, 174,000,000 acres; Brazil fourth, with 135,000,000 acres, and then in succession Scandinavia, Austria, Germany, France and Italy, down to the countries of less consequence in forestry. Since 1848 the French, who have been most industrious in this direction, have converted 9,000,000 acres of waste land into forest. Paris alone burns the timber of 50,000 acres annually, requiring a million acres of forest to keep up the supply.

Forty billion feet of lumber is yearly

used by the United States for the lumber and paper trade. This is equivalent to the product of about 4,000,000 acres of good virgin forest, an area equal to Rhode Island and Connecticut combined. This does not include the wood used for fuel, which is about four and a half times more. Four million feet is used for matches, the product of 400 acres of good virgin forest. About 620,000,000 cross ties are now laid on American railroads, and 90,000,000 new ties are required annually for renewals. There are now standing nearly 7,500,000 telegraph poles and 750,000 new poles are required each year for renewals. These figures do not include telephone poles and the poles required on new railway lines. The timber used for ties and poles each year is equivalent to the product of 100,000 acres of good virgin forest. The amount



LOGGING CAMP IN MICHIGAN.



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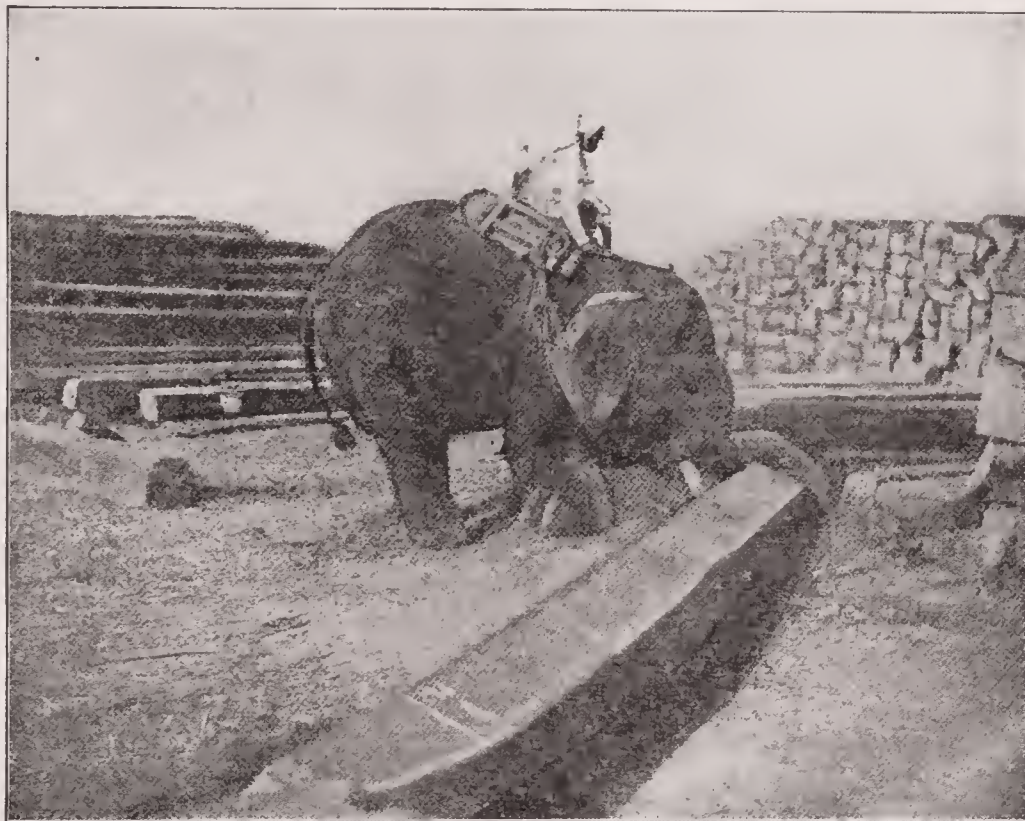
RAFTING SAW LOGS THROUGH A DRAWBRIDGE—UPPER MISSISSIPPI RIVER.

of wood used in a single year for making shoe pegs is equal to the product of fully 3,500 acres of good growth hard wood land. Lasts and boot trees require at least 500,000 cords more. Most newspaper and packing paper is made from wood. The total annual consumption of wood for paper pulp is equivalent to more than 800,000,000 board feet of timber, equal to the growth of 80,000 acres of prime woods. It is manifest that with such enormous inroads upon the forest areas of the United States, the time might come when the country would be virtually denuded of trees, if no measures were taken to prevent such a disaster. The effect of that would be much more far-reaching than the mere termination of the fuel-wood supplies, and the supplies of wood for all the other purposes here-

tofore mentioned, for the denuding of a country means its certain reversion to a desert condition. It is the forests that shelter and preserve the rainfall, yielding the streams that flow down into the prairies of our agricultural states. If the Rocky Mountains, for instance, were to suffer the loss of their forests, the snows which cover them in the winter would melt rapidly during the first days of spring time, and would flow away in disastrous floods, destroying the farms below. Later in the season, when water was needed, there would be none, and farms would suffer perpetual drought.

Under the forests' shade, snow drifts, however, melt gradually throughout summer, thus supplying never-failing streams for the watering of the thirsty crops in the valleys below.

Recognizing these facts, Americans with foresight and prudence have induced the government to establish forest reserves in



ELEPHANT PILING TEAK LOGS, BURMAH.

the United States, where no timber may be cut except under the most rigid and exacting restrictions. There are forty-one of these forest reserves in the United States, created by presidential proclamations according to an act of Congress, and embracing a total estimated area of 46,410,209 acres. The greatest of these is in Oregon, in which state a single reserve includes 4,588,800 acres. California, Washington, Colorado, Idaho, Montana, Wyoming, Utah, South Dakota, New Mexico, Oklahoma, Arizona and Alaska are the other states and territories in which forest re-

erves have been established by national law. With this protection, in spite of the depredations that are sometimes committed by forest fires and vandal woodsmen, we may expect that some of these great forests will be preserved to posterity.

The forests of the eastern section contain large areas of both deciduous and evergreen trees, including maple, oak, chestnut, birch, hickory, walnut, beech, linden, elm and locust. Characteristic trees of the south are oak, long-leaf pine, magnolia and palmetto. The cone-bearing trees include valuable cypress, spruce, hemlock, cedar and larch.

The forest areas of the Rocky Mountain ranges bear conifers, aspen and oak. The magnificent forests of Washington, Oregon and California are unrivaled. The trees, chiefly conifers or evergreens, include Douglas fir, yellow pine, sugar pine, and valuable redwood. The standing timber in the United States is estimated at 2,300,000,000,000 feet and the annual cut is 40,000,000,000 feet. Of this conifers constitute three-quarters and the oak and other hard woods the remainder.

In the early history of the country the chief lumbering interests were in Maine,



LOG JAM IN THE LUMBERING REGION OF MICHIGAN.

and the industry there remains very important, although far exceeded in later years by some of the western states. Michigan leads all other states in the lumber industry, with an annual production of nearly 5,000,000,000 feet of lumber and many other incidental products from the timber that is cut. The lower peninsula in Michi-

very great, with Oregon and Washington in the lead.

The work of the lumbermen in the northern forests begins in the winter, when hauling on great sleds becomes the easiest way to bring the logs out of the forest. The life in the logging camps of Michigan at this season is one of hard work and little idle-



SAWING A BIG LOG IN AN OREGON MILL.

gan contains the most extensive pine forests in the country, although the area now is largely reduced. Wisconsin and Minnesota are likewise leading states in the production of lumber and in the other forest industries. Georgia, Louisiana and other southern states produce large quantities of hard pine, and such other forest products as turpentine, pitch and tar. The lumber industries of the Pacific coast states are

ness, but the men become strong in it, and return to the same employment year after year. The logs are hauled over the snow to the banks of the rivers, to await the thaw in the spring. When the ice breaks and the melting snows cause the streams to rise, the logs are picked up by the current and carried down stream rapidly toward their destination. This is usually a milling town at the mouth of the stream, where the logs



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COTTON READY FOR EXPORT ON WHARVES AT SAVANNAH, GEORGIA.

are turned into lumber. It is at this time that the "log jams" or blockades occur, which call for such bravery on the part of the strong men who are urging them down stream, to break the jam and start the flow once more. On the larger rivers, the logs are sometimes lashed into huge rafts, and are towed by steamers to the milling towns. This is characteristic of the upper Mississippi and some of the larger rivers which flow into it.

It is these lumbermen who have given to us the material from which millions of homes have been built, our furniture produced, our houses heated and a multitude of other important commercial and domestic necessities provided.



TEXTILE FABRICS IN AMERICA

As civilization advances, mankind takes more thought how to be fed and sheltered and wherewith to be clothed. No longer do rude garments of rough skins serve the purpose. Instead, if skins are utilized, they

must be the finest furs of the rarest northern animals, cut according to the fashion of the current season and finished with skill and beauty. Wool from the sheep, the camel and the alpaca is sheared, woven and marketed all over the world. Fiber plants are cultivated and utilized most deftly for the making of such fabrics as appeal to the

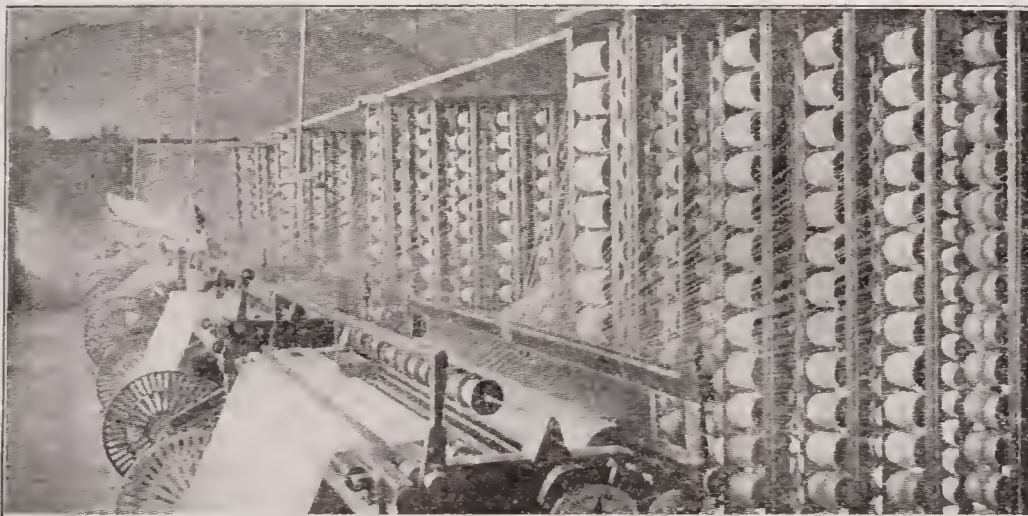


IN A COTTON MILL—TEARING RAW COTTON FROM THE BALE.

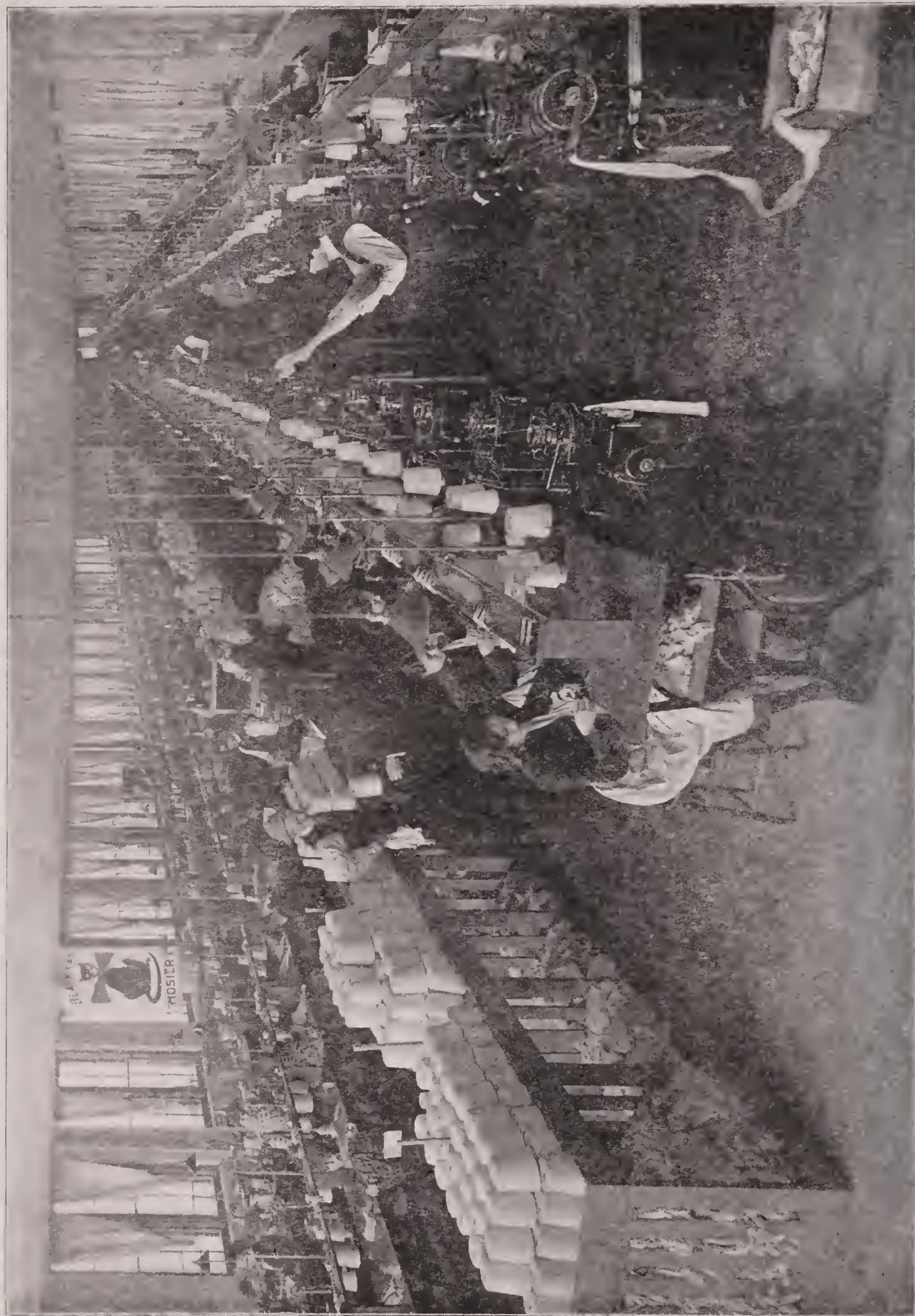
taste. Cotton is not the only vegetable fiber in use for thread, cloth and garments. In different countries, hemp, flax, jute, ramie, cocoanut-bark, pineapple fiber and other products are used locally for the production of cloth. The world over, however, cotton, wool and silk are the materials from which the garments of mankind are made. Linen is much reduced in favor, of late years, as cotton has multiplied. Silk, indeed, is the only fabric materially gaining on cotton and wool, and its advance is a natural one,

justified by its beauty and explained by the increase of large trade with Japan, China and India, whence so much of the silk comes.

The United States is the leader in the world's cotton trade. This valuable product was first raised in the United States in Virginia in 1621, and was first ex-



COTTON WEAVING, FROM THE SPOOL TO THE CLOTH.



MAKING HOSIERY—INTERIOR OF A GREAT STOCKING MANUFACTORY.



WEAVER AT THE LOOM.

ported from this country in 1747. Within the next fifty years the progress of the industry was steady, but the difficulty in separating the seed from the fiber was the cause of slow growth until, in 1793, Eli Whitney invented the cotton-gin. Since that time, the increase has been enormous and uninterrupted, except during the Civil War, when industry in the south virtually ceased. By this time the acreage annually planted to cotton in the United States approximates 25,000,000, and the annual production is above 10,000,000 bales, the annual value of the crop being about \$325,000,000.

Egypt and India are the countries with the greatest cotton production after our own, but they fall far behind this country. All of our southern states produce cotton, with Texas standing at the head of the list, Georgia and Mississippi as close rivals next, and South Carolina, Alabama, Arkansas, Louisiana and North Carolina following in that order. The greatest cotton

shipping ports and markets are Galveston, New Orleans, Mobile, Savannah, Charleston and Richmond.

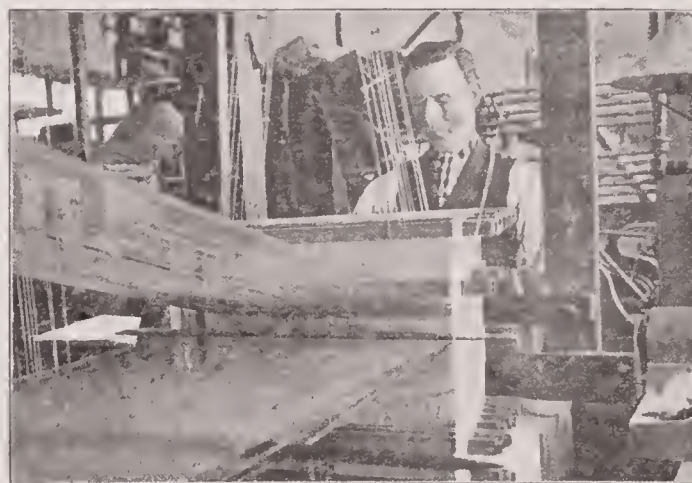
The manufacture of cotton in the United States has been growing rapidly in recent years. In 1890 the number of establishments for the preparation and manufacture of cotton and cotton goods was 2,641, and the capital employed was \$366,000,000. For the manufacture of cotton goods alone, apart from mixed goods, there were 905 mills, with an aggregate capital of \$355,000,000, employing 222,000 hands. The annual cost of material used was \$155,000,000, and the value of the products \$268,000,000. Ten years later the showing was

greatly increased, chiefly by the establishment of numerous important mills in the southern states themselves. The tendency indicates that the time has come to take advantage of the cheap labor of the south, and the proximity of the cotton

fields, to operate more economically and evade surplus freight on raw material.



SILK WINDERS AT WORK.

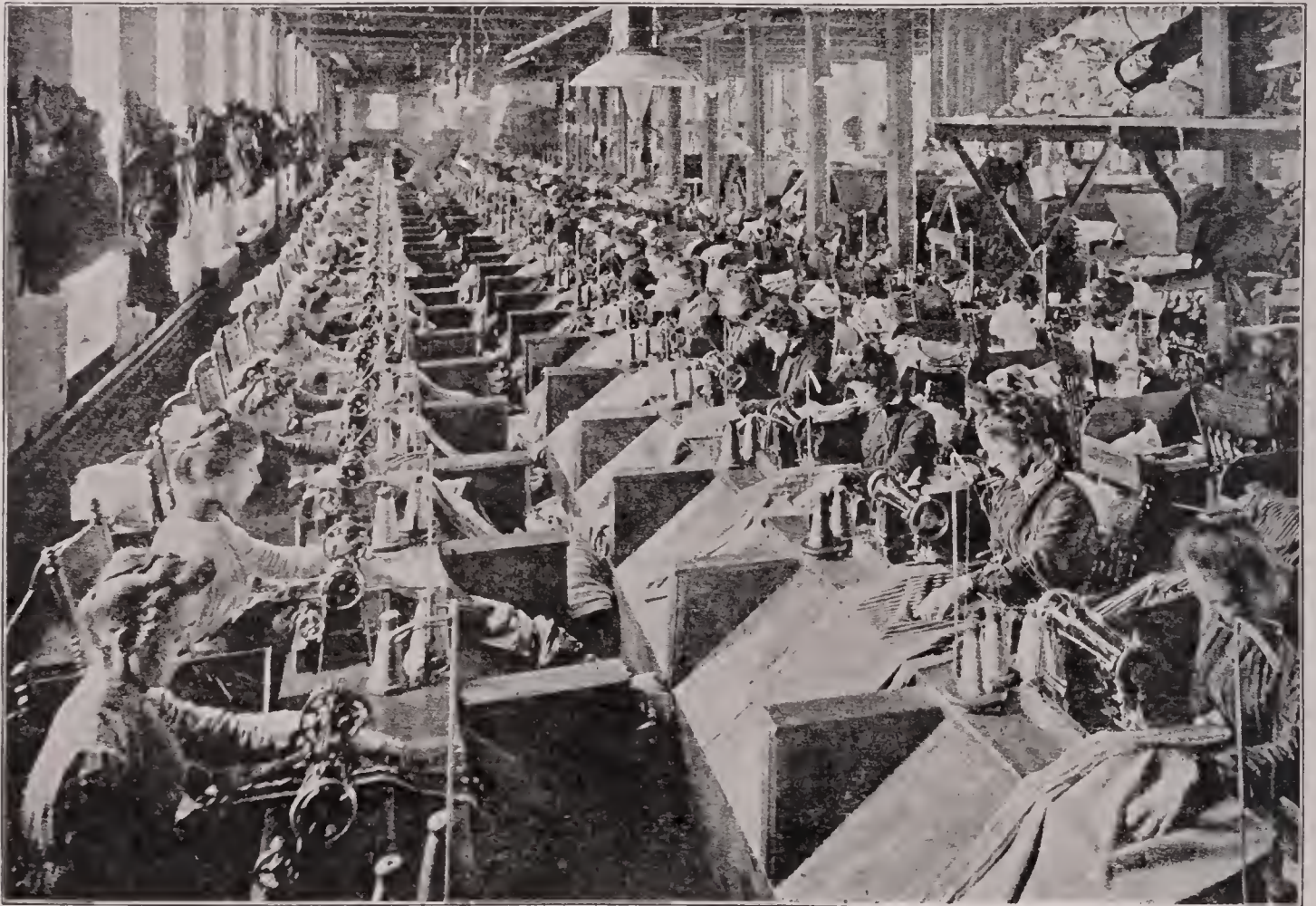


WEAVING VELVET IN A SILK MILL.

The New England states still stand at the head in the manufacture of textile fabrics. The first cotton mill in the United States was established at Beverly, Massachusetts, in 1787, and one of the first woolen mills at Newbury, only seven years later. Rhode Island is only second to Massachusetts in its cotton mills and likewise stands high in woolen and silk manufacture. Pennsylvania leads in the middle states in cotton and silk. New Jersey stands at the head of the list in the United States in silk manufacturing, with 257 factories, and a capital invested exceeding \$20,000,000. There are 26,000 persons employed and an annual value of output of \$43,000,000. Among the southern states, North Carolina, South Carolina,

Georgia, Alabama and Mississippi have important cotton mills.

The wool clip of the United States approximates 270,000,000 pounds annually, from 36,000,000 sheep. It is in New England and the eastern states that our American woolen goods are chiefly manufactured. The value of the woolen manufactures of Massachusetts alone is about \$75,000,000 a year. Nearly all the hemp from which our rope and other hemp products are made, comes from the Philippines, which have a virtual monopoly of the world's product. The development of textile industries is constant and there is an evident improvement apparent in the quality and the artistic beauty of the materials produced.



OPERATIVES IN A GREAT GARMENT FACTORY.
All these sewing machines are driven by electricity.

PAPER, ITS HISTORY AND HOW IT IS MADE

In the earliest times it was realized that the information of the world must be perpetuated, if true progress were to be obtained, otherwise each generation would have to learn for itself as its forefathers had done, without having the advantage of the experience already gained. So at first primitive man used the only tablets at his command and engraved strange hieroglyphics upon stone, to tell what was desired to be preserved. In the height of Egyptian civilization obelisks, pyramids and slabs of stone took the place of the ruder tablets. Later clay and terracotta were used for the making of tablets, and great libraries were even formed, portions of which are still preserved, to give us the history of the Chaldeans, the Babylonians and the Assyrians. As time passed other

materials were introduced, plates of metal, skins and bones of animals, ivory, wood and wax being used.

It was Egypt that gave us the real forerunner of paper, and, indeed, the name itself, by a material made from the graceful water plant of the Nile, the familiar Egyptian bulrush or papyrus. Out of the pith of its stems were made sheets of a material not much indeed like the paper of to-day, but the pioneer of paper manufacture. Rolls of this material were made into books, and a large amount of the history and literature of the time was thus preserved for the use of students of to-day. The Chinese, about the same time, were independently learning to make paper from rice and silk. The first rival of papyrus was parchment prepared from the skins of sheep and goats.



SORTING RAGS FOR FINE BOOK PAPER IN A PAPER MILL.



THE RAW MATERIAL OF THE DAILY NEWSPAPER.

Spruce logs waiting to be floated down to the pulp mills, where they are to be made into printing paper.

It grew in favor, owing to the partial exhaustion of the papyrus beds on the Nile, and because the Egyptians wanted to hold a monopoly and raised prices of their product beyond all reason. The next step forward was the invention of paper as we have it to-day.

Like a great many other inventions of present value, the first European knowledge of paper-making came from the Chinese. They had been making paper for more than 1,000 years when, in 1189, the art was introduced into France, the first country of Europe where it was made. The Arabs had learned the art from the Chinese, and from them it passed to western Europe through the Crusaders who visited the Moslem countries. The Dutch were the next Europeans to make paper, and the English followed, about the time of the discovery of America. Long before this, however, the Saracens had introduced paper-making into Spain, whence it had reached Italy.

The first paper mill in America was established at Germantown, Pennsylvania, in 1690, by a paper-maker from Holland, one of the owners of the mill being the printer who some years later gave to Benjamin Franklin his first employment in Philadelphia. During the early history of paper making, rags were the only material used. The scarcity of rags was so great that the mills had to continually appeal for them by advertisements and solicitation, and the paper mills in the thirteen colonies grew in number so rapidly that the scarcity of material caused much inconvenience.

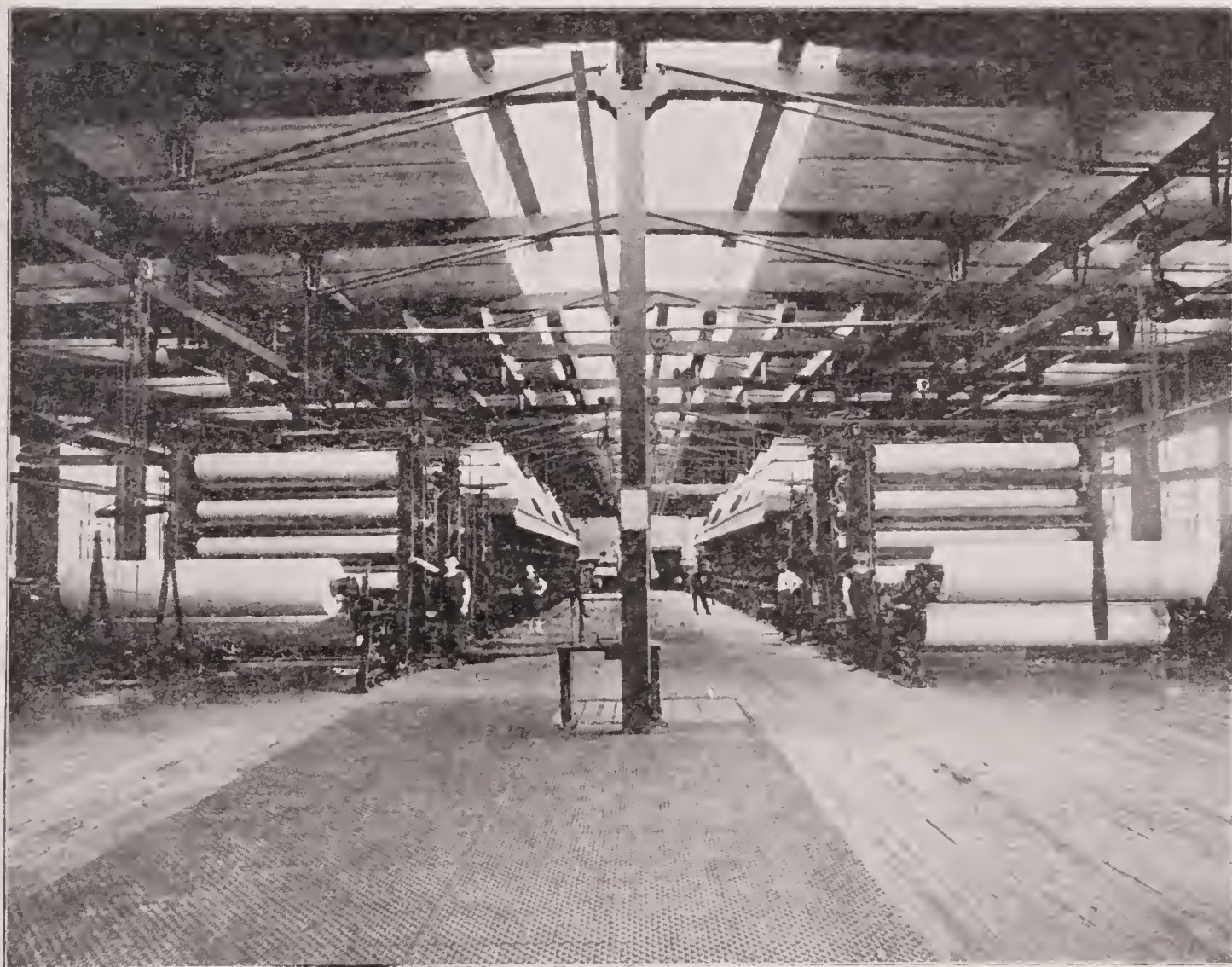
Before the most recent modern processes of paper-making had been invented, the production was much more expensive and slower. Everything was done by hand, and it took three men a day to finish 4,000

small sheets of paper, while from the beginning to the end the process required about three months. This is a striking contrast to the conditions of the present, when by machinery paper can be made from the tree as it stands in the forest within twenty-four hours. But little hand-made paper is used in America, except for special purposes. But all Bank of England notes are printed on linen paper, made by hand, with but two notes to a sheet.

The better and more expensive grades of paper are still made from rags, gathered and shipped in great quantities from all parts of the country and indeed from all over the world. China is one of the most

important of the rag markets. They come to the factories in all conditions of filth, and the processes of sorting and cleaning are of the utmost importance to the perfection of the product. The mills making the highest grade bond paper, and that used for our paper money, use nothing, however, except new rags fresh from the mills or from garment factories where the trimmings are saved for the purpose.

When sorting and cleaning are done, the rags are chopped into small pieces, boiled for a day under steam pressure, and finally treated with chemicals for an additional cleaning and bleaching of the resulting pulp. By this succession of processes the



INTERIOR VIEW OF A GREAT PAPER MILL.

dirty rags from the streets come forth a mass as white as milk. The pulp is drained and dried to a proper consistency, and finally passed through a great machine which converts it into the paper itself. By the flow of pure water the liquid pulp is spread out evenly over a wire cloth into a sort of web of damp paper, which is delivered on

material. The surfaces are given a gloss or polish, or a rough or antique finish, according to the purpose for which it is intended.

Although the more expensive papers are made from rags, the great bulk of what is used in books, magazines and newspapers comes from wood pulp, the newest devel-



AT WORK IN A BOOK BINDERY, FOLDING MACHINES IN THE FOREGROUND.

an endless belt of moist felt. Successive squeezings and scrapings dry the paper, smooth it and give it strength. From this point the additional processes are merely those for finishing different grades of the

opment in modern paper manufacture. The different fibers used in paper-making, whether of wood or rags, do not differ greatly after their mechanical and chemical treatment is finished. When the logs are

cut in the forests, the bark is stripped from them and they are sent to the factory. Here they are sawed and split into small blocks, after which they are ground to a powder which becomes a pulp when diluted with water. This pulp, chemically treated to bleach it and to remove all resinous and foreign matters, then passes through processes similar to those by which paper is made from rags.

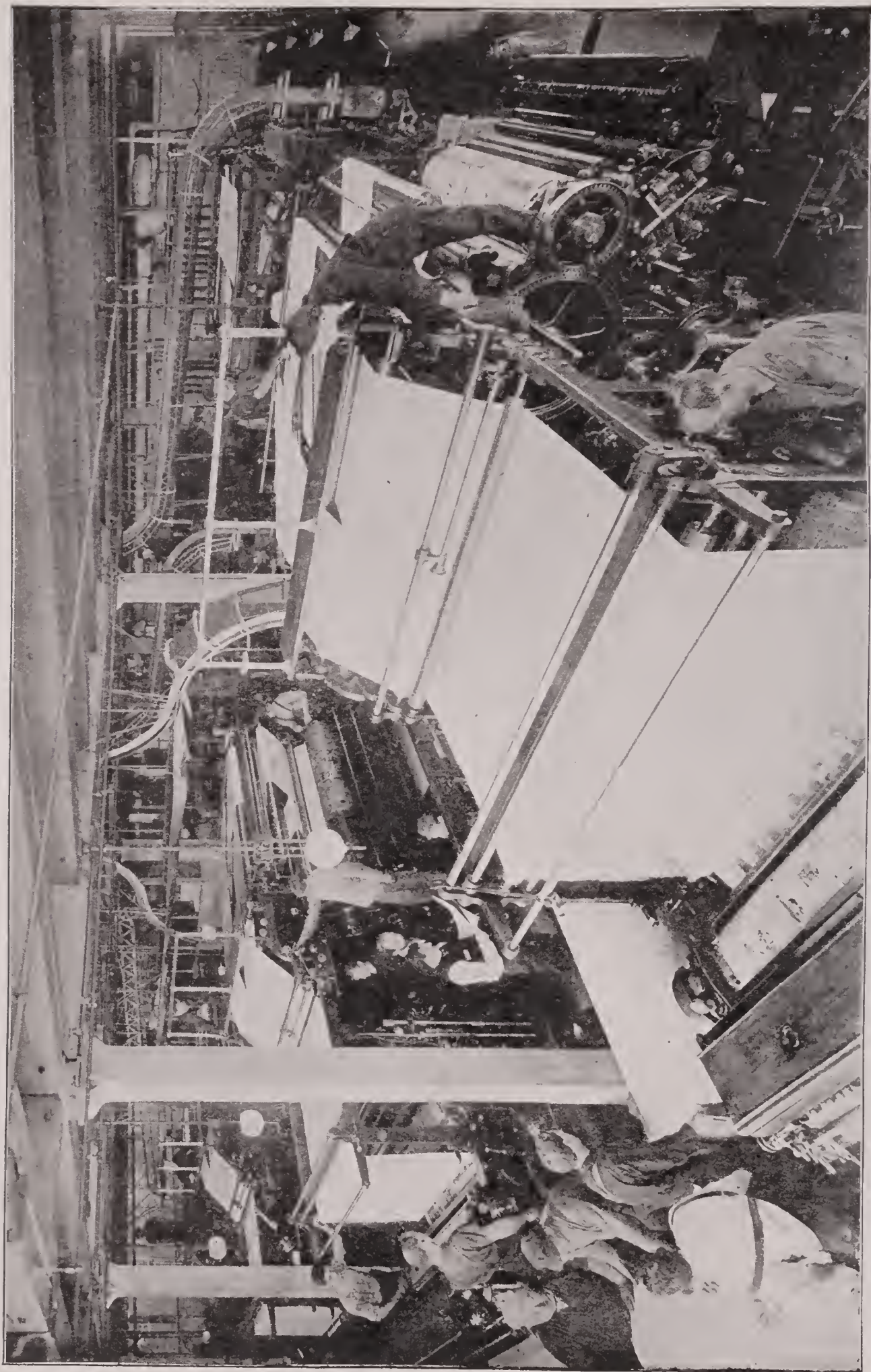
All of the paper from which our greenbacks and bank notes are made comes from one mill. It is made from the finest new,

clean linen rags, and there is a special attachment on the machine by which the silk threads always seen in our paper money are introduced. It is forbidden to make such paper for private use, under the same penalties that apply to counterfeiting.

Paper fills an important place in many mechanical arts, and there are various novelty papers made which have important uses. Paper made with a quantity of asbestos fiber is used for fire-proofing purposes; tar paper is used for covering roofs and lining walls; photographs are made up-



TRIMMING AND MAILING MAGAZINES IN A BINDERY.



PRESSROOM OF A GREAT METROPOLITAN NEWSPAPER.

The peculiar curved troughs or channels, rising from the presses to the ceiling, are the carriers through which the completed papers are hoisted automatically to the delivery rooms above.

on paper rendered sensitive by a chemical process; carbon paper, transparent paper, stencil paper, gunpowder paper, safety paper for bank checks, and other familiar forms are but developments of the ordinary paper products. Sand and emery papers are prepared by coating a sheet of paper with glue, and then sprinkling sand or emery dust upon the surface. Car wheels, lumber, buckets and tubs, and many articles of common use are made from paper pulp.

The United States leads in paper-making, producing about one-third of all that is used on the globe. The city of Holyoke, Massachusetts, is the greatest paper center in the world for expensive papers of linen. The cheaper grades of paper, from wood pulp, are made in great quantities in the mills of Maine, Canada and Wisconsin, convenient to the forests which provide the material.



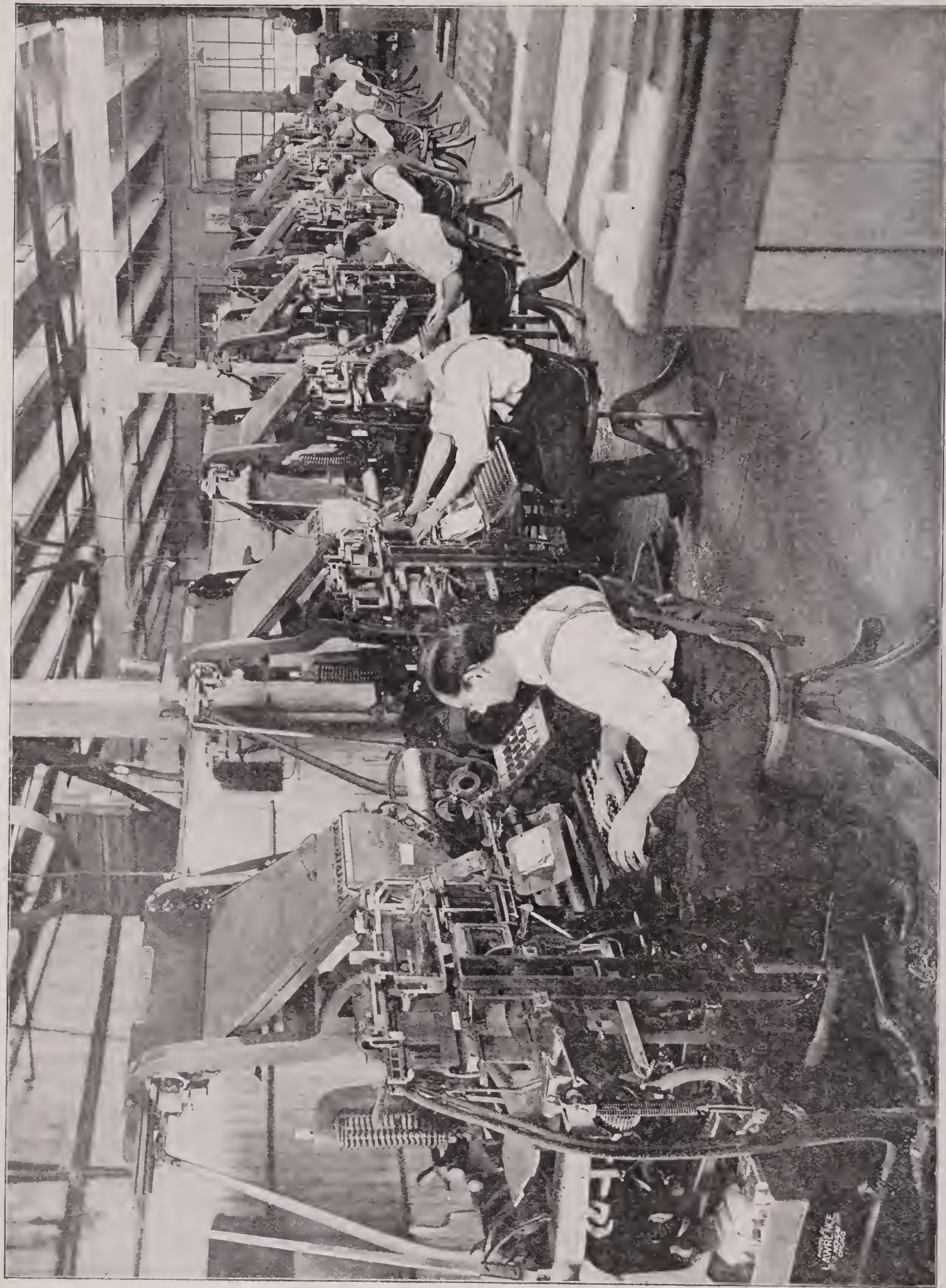
HOW A GREAT NEWSPAPER IS MADE

Like the industries and the affairs of the world which it records, the modern newspaper has grown to a magnitude and an influence never dreamed by the pioneers of the press. Perhaps not changed greatly in the smallest towns, where the newspaper proprietor may embody in himself all the editorial and mechanical labors of his office, in the city it is a very different institution.

In order that the morning paper may be read by its thousands of subscribers at their breakfast tables, sometimes hundreds of miles from the place of publication, hundreds of employees must work in one de-

partment or another to produce and circulate the printed pages. In fact, the work of producing the paper begins long before the time of its publication, and enlists the energy of men who may be far away. The material equipment of presses, machinery and type comes from great factories where the highest mechanical ingenuity is employed to perfect the processes. The paper mills must turn out miles of broad, white ribbon, which, when printed and folded, becomes the morning paper. Back of the manufacturers and the paper mills come the miners, who toil deep in the earth to produce the metals, and the lumbermen of our northern forests, who cut and raft the logs from which the paper is made. Correspondents the world over keep a multitude of telegraph operators busy, transmitting the important facts of the day to the office from which the paper is to issue. Railways run special trains to insure prompt distribution of the finished journal, and by the time the newsboys, the clerks in the business office, and the editorial staff itself are added to the list of participants, the number who from the beginning to the end have shared in making the paper, which the reader buys for a cent, is an astonishing one.

In order to carry on all these manifold operations harmoniously, and without delay at a critical time, a great newspaper must be organized with the utmost care. The business, the mechanical and the editorial departments have their distinct functions, all of prime importance. It is the business department that does the work of securing subscriptions and advertisements, circulating the paper to subscribers, collecting bills and paying expenses. It is a self-evident fact that a carelessly managed business de-



LINOTYPE COMPOSING ROOM IN A DAILY NEWSPAPER OFFICE.

One of these machines will set as much type as half a dozen hand compositors. They are used in almost all large printing establishments.

partment could soon destroy the most ably edited publication.

The mechanical department receives from the editorial staff of writers and artists, the articles they have written and the pictures they have drawn, and, from the business department, the advertisements which have been received for publication. Out of this material the finished product is made, by the various processes of type-setting, zinc-etching, stereotyping and printing.

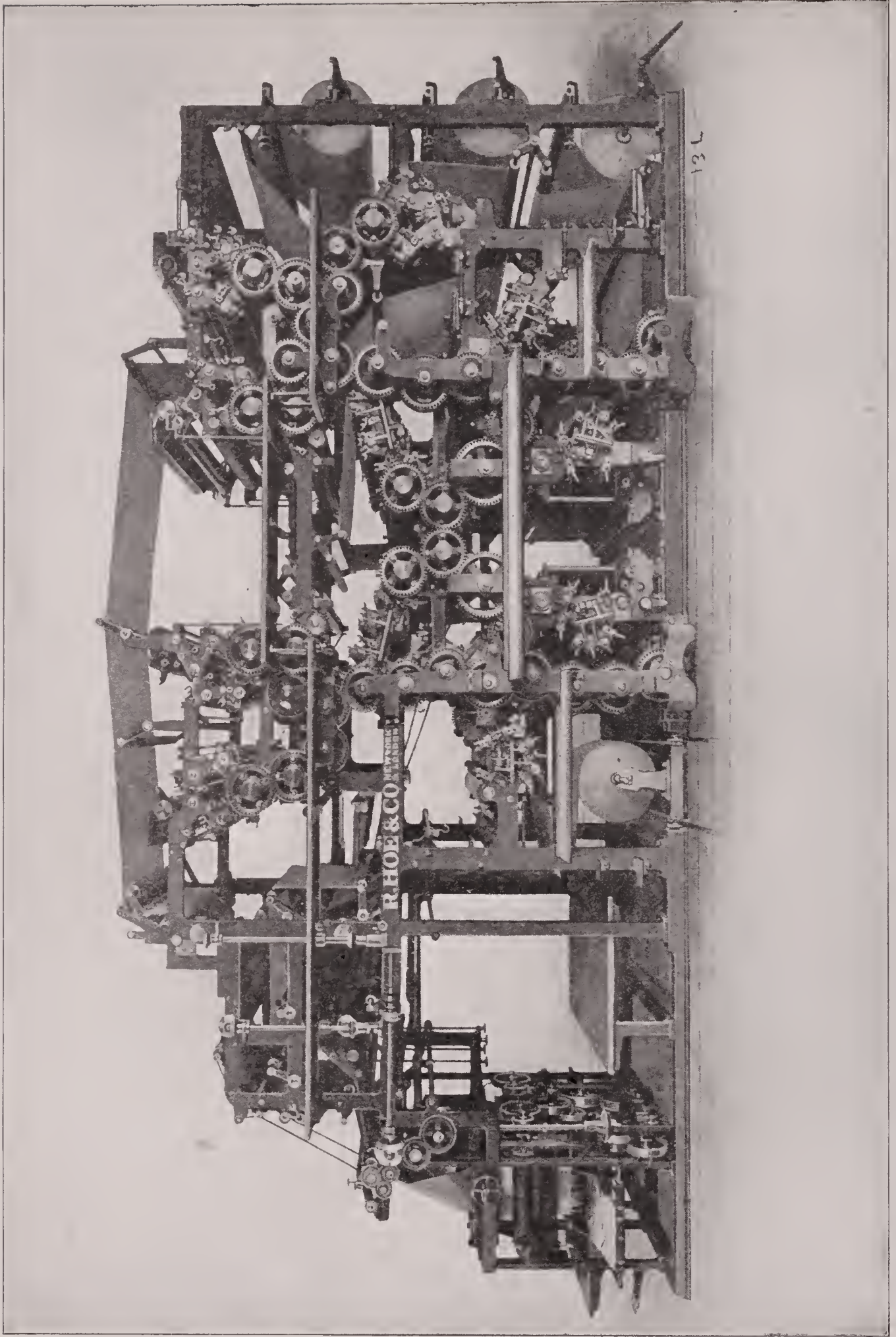
The editorial department is the one first thought of by the reader, for from this department come the various articles of news, criticism, opinion and fact that go to make up the printed sheets.

The editorial staff of a newspaper is directed by the managing editor, who is himself, like the business manager and mechanical superintendent, responsible directly to the publisher. Under the managing editor are the numerous out-of-town correspondents, who send matter by mail and telegraph; the city editor and his reporters, who gather the local news and write it; the special writers who furnish dramatic criticisms, sporting news, literary or musical notes and the like; and the copy readers, who give final revision to all this matter after it has been written, in order to be sure that the style and policies of the paper are conformed with, that errors are guarded against, and that nothing libelous is included. The artists, too, report to the managing editor or city editor, because their work, while pictorial, must conform to the general style of the paper.

Once the manuscript has been prepared and finally revised, it goes to the composing room, into the hands of the mechanical department. Except in the smaller offices, the

old method of setting type by hand has been done away with, by the invention of a mechanical device called the Linotype machine. By this machine one type-setter can accomplish as much as five or six hand compositors, with a higher average of accuracy. The Linotype, invented and perfected by Ottomar Mergenthaler, is a cumbersome and complicated apparatus, but it achieves its purpose with what seems almost human deftness and skill. The operator sits before the keyboard, not unlike that of a typewriter. The upper part of the machine is a magazine of molds or matrices, each in its own box, and carrying at one end the form of a printed letter. In another place there is a quantity of molten typemetal, kept heated by a gas flame. As the operator taps the keys indicating the letters he desires to use, each matrix slips from its box in proper order and falls into place in a little tray made for the purpose. When these have assembled, to the length of a full line of type, an arm controlled by a lever lifts them to a set of clamps, where an impression is taken from them in the proper quantity of the hot metal. This is the line-of-type, cast in one piece, which gives the machine its name. The matrices are carried up to the magazine again by another arm, and by an ingenious device each is distributed to its proper place once more.

When the article has been put in type in this fashion from the manuscript, an impression is made from the type, called a proof, and this is sent to proof-readers, who examine it for errors which must be corrected. When the type has accumulated sufficiently to be classified, or made up into the page of the paper, this is done, and the entire page sent to the stereotyping room. The printing of great papers is not done di-



OCTUPLE ROTARY COLOR PERFECTING PRINTING PRESS.

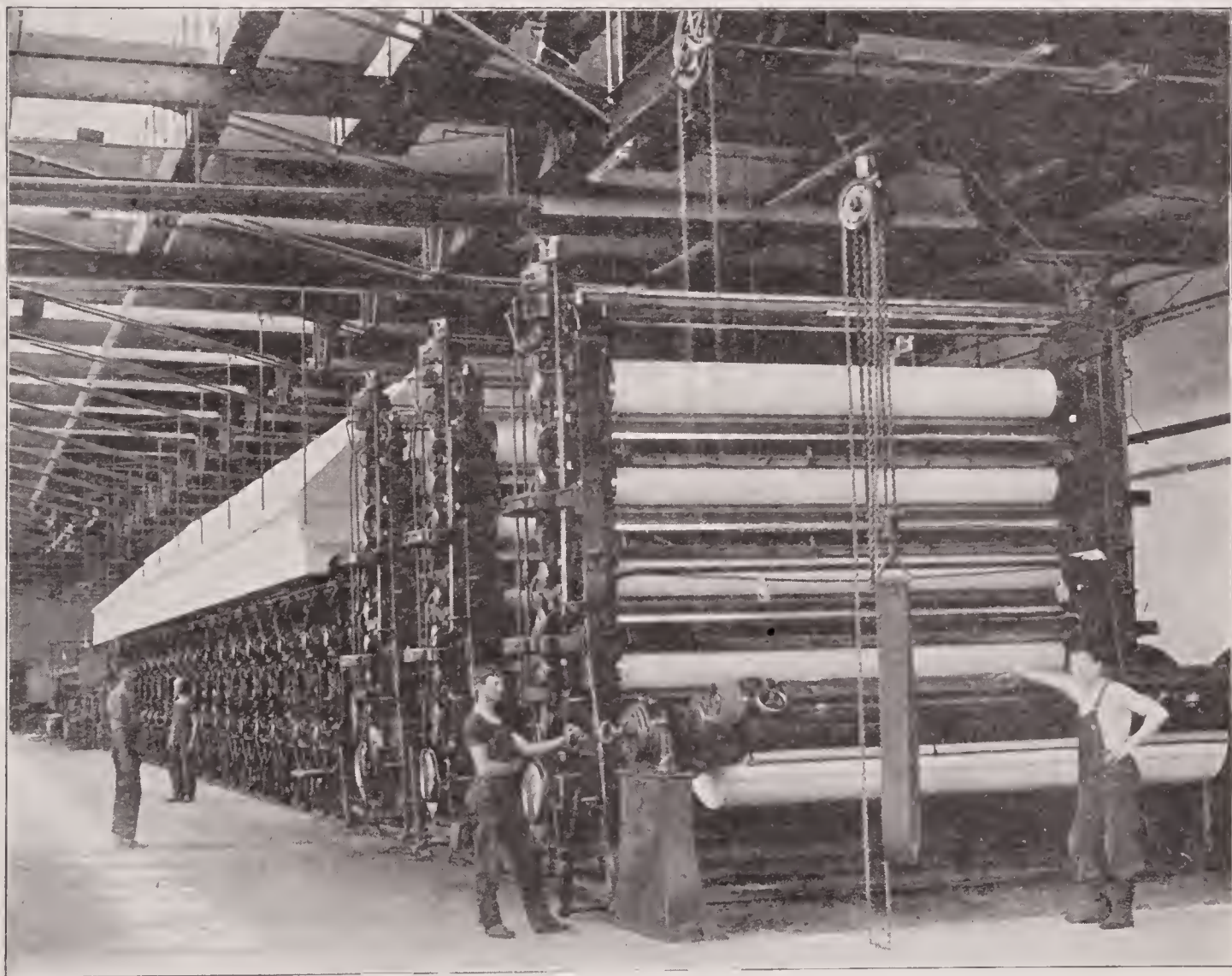
This is the latest development of modern printing machinery as used in the greatest newspaper offices. It will print, cut, fold and paste 48,000 complete 16-page papers every hour with the cover pages printed in four colors. It is the largest printing press that has ever been constructed, and costs \$60,000.

rectly from the type cast. The size of the editions requires that several presses should be at work simultaneously, in order to issue the paper in time. Duplicate plates are therefore made from the type pages, by the process of stereotyping, as many as are necessary for the number of presses used. These stereotype plates are not flat, but curved into a half circle, so that they may be clamped on to the cylinder of the press used for printing.

The pictures drawn by the artists are reproduced by a photographic process, which transfers the picture to a sheet of zinc, that is then treated with nitric acid to bring out the artist's lines. After such an engraving

is finished, it may be placed in the page of type and stereotyped like the type itself.

The perfecting printing press of the newest design and largest size is one of the most interesting pieces of mechanism to be found anywhere. The curved metal plates, or "turtles," from which the printing is done, are locked in place; the rolls of paper like great bolts of ribbon, perhaps six feet wide and five miles long, are hung in place on the press; the ends of the strips of paper are woven through the labyrinths of rollers, cylinders and wheels of the machine, an electric button signals the starting, and the clamor begins. Then from the further end of the press begin to fall the folded newspa-



MACHINE FOR MAKING WHITE PAPER FOR NEWSPAPERS.

pers, printed, pasted, even addressed if they are intended for the mail, at a rate of 24,000, 48,000 or even 96,000 an hour. Truly a battery of half a dozen such presses, multiplying the printed pages for a myriad of readers, should be a more effective force in the world than a battery of artillery thundering against an enemy.

* * *

HOW BOOKS AND MAGAZINES ARE ILLUSTRATED

The great increase in book and magazine illustration, made possible by the improvement of mechanical devices, has brought about the establishment of important business concerns, devoted entirely to the making of pictures. Various processes are employed in publishing houses for the illustration of the books, magazines and newspapers which they produce, but the most effective and artistic of these for general

purposes is that employed in the volume herewith presented. It is a photo-engraving process, producing what is known as half-tones.

It was found that by photographing the picture or object desired for reproduction, through a fine screen of muslin or wire gauze, or lines scratched on a glass plate and then filled up with ink, the little squares in the screen would separate the rays of light according to the strength of the lights or shadows of the picture. Where the shadows are most intense the rays run together, so that the effect on the plate is of the black shadows running all together, but where they are lighter, the rays form little dots upon the plate, while in the high lights or white places it is still more dotted.

If you will take the magnifying glass and examine any half-tone engraving, you will see that the whole picture is made up of little cross bars. This effect of the screen



OFFICE OF A GREAT ILLUSTRATING AND ENGRAVING COMPANY.

is called "stippling." The screen is placed just in front of the plate to be photographed upon, in the camera, and as the rays of light come in through the lenses they are diffused according to the intensity of the lights or shadows in the object being photographed. The screen is ruled in little bars, with lines from eighty to 150 to the inch. They are so small that they hardly appear as lines when the cut is viewed at a little distance, and by the process described they produce a picture upon a copper or brass plate almost a counterpart of the photograph.

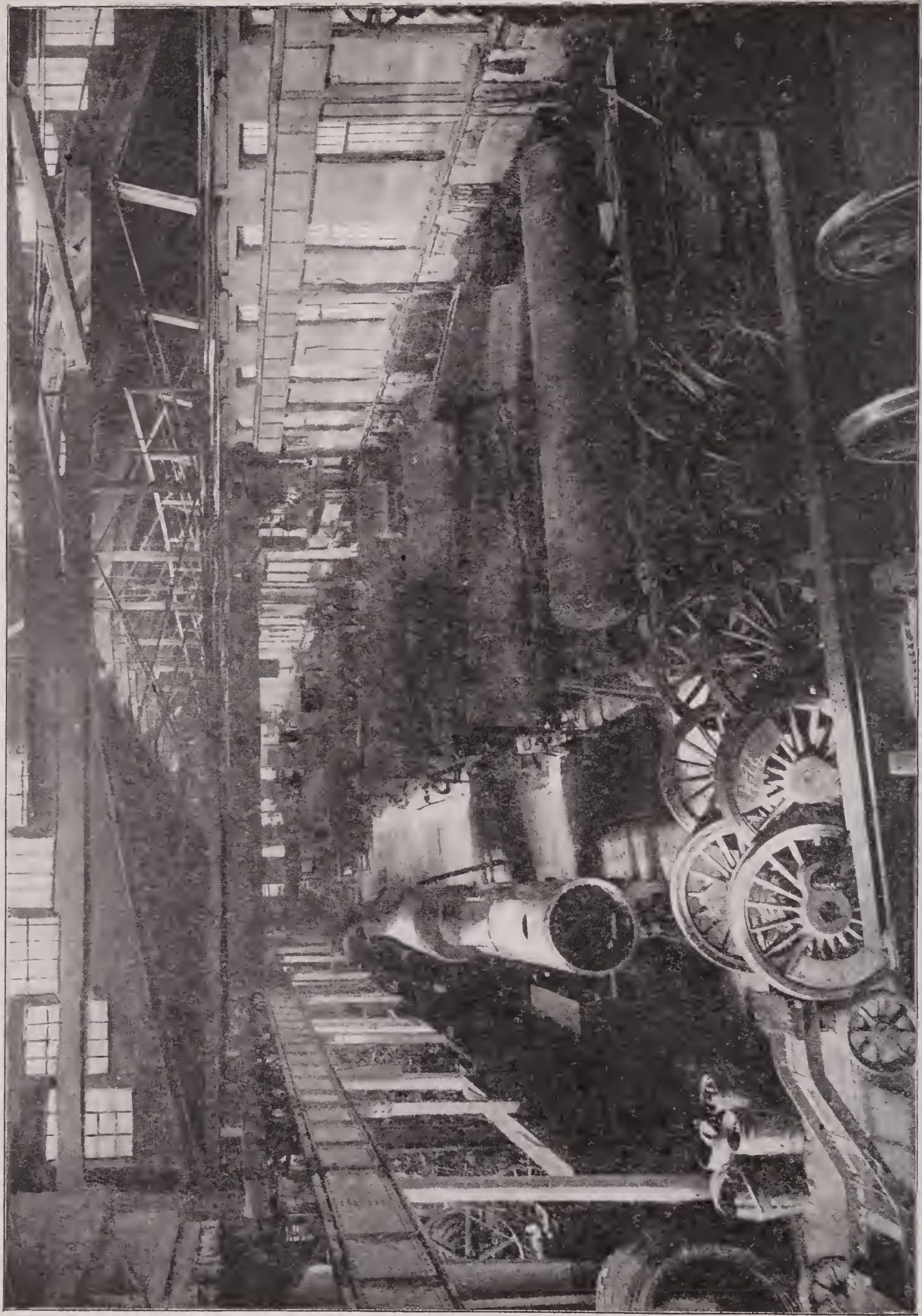
The coarser line engravings used in newspapers are made with great rapidity by a process known as zinc etching. The artist draws in India ink the picture to be produced, making his sketch much larger than it is to appear in the paper. The process of engraving reduces the size and at the same time improves the work of the artist. This drawing is next photographed and developed by ordinary processes, and from the negative a print is made on a sheet of sensitized zinc, just as one would print an ordinary photograph on sensitized paper. The zinc plate is treated by a developing process that shows up the lines of the picture, and after this it is given a bath in nitric acid that eats away the exposed surface of the zinc plate and leaves the photographic lines standing out. Repeated etchings by acid, and retouching by skilful engravers, with sharp tools, bring the plate to final perfection, after which it is mounted on a metal base and is ready to be used in printing.

Colored pictures are made by a process similar to that of the half-tones, with some additions. Three plates are made of the same subject, which are used respectively with three different inks, red, yellow and blue. Such colors combined in proper pro-

portions, by printing one on top of another, will give any shade or color desired. One plate is arranged for printing the blue, another for the red and another for the yellow. Each picture must go through the press three times for these colors to be put on, one at a time, and of course the work must be very accurate so that the successive impressions will be in the right place. When the work is finished, however, if this is done properly, there is a remarkable colored picture produced, with artistic effects, and yet at great speed and moderate expense.

Not merely mechanical processes, but genuine artistic ability as well, must be employed to obtain such results. The one to whom this work is given, carefully studies the subject to be printed, as to its color; and the proper combination of inks to produce the desired colors is decided. The first plate of the three is then arranged for printing in blue. All that portion which is to appear in heavy blue has a heavy surface left on the engraving; the lighter shades are stippled more, eaten out by the acid or carved out by hand, according to the degree of intensity needed. That portion which needs blue in combination with one or both of the other colors is shaded in proportion. This plate, after being thus made ready, is marked near the edges with lines which aid in printing the next color, exactly on top of the first at the proper place.

Next the plate from which the yellow is to be printed is prepared in the same way, and the red plate completes these preliminaries. Proofs of each plate are taken separately and together to see if the right color scale has been worked out. If the final proof is correct, the register marks should exactly coincide, and the colors



LOCOMOTIVE BOILERS IN THE PROCESS OF CONSTRUCTION.

should blend so that they appear to be printed by a single impression. The completed work is a perfect colortype, resembling a half-tone photographic engraving in the natural colors.

The chromos of a few years ago are entirely superseded by the process thus described, which in addition to being much more satisfactory and artistic in its results, is more rapid and far cheaper. The new process has made it possible for beautiful pictures, colored as in nature, to be possessed by multitudes of lovers of beauty and art, at small cost, and house decoration is greatly aided thereby.

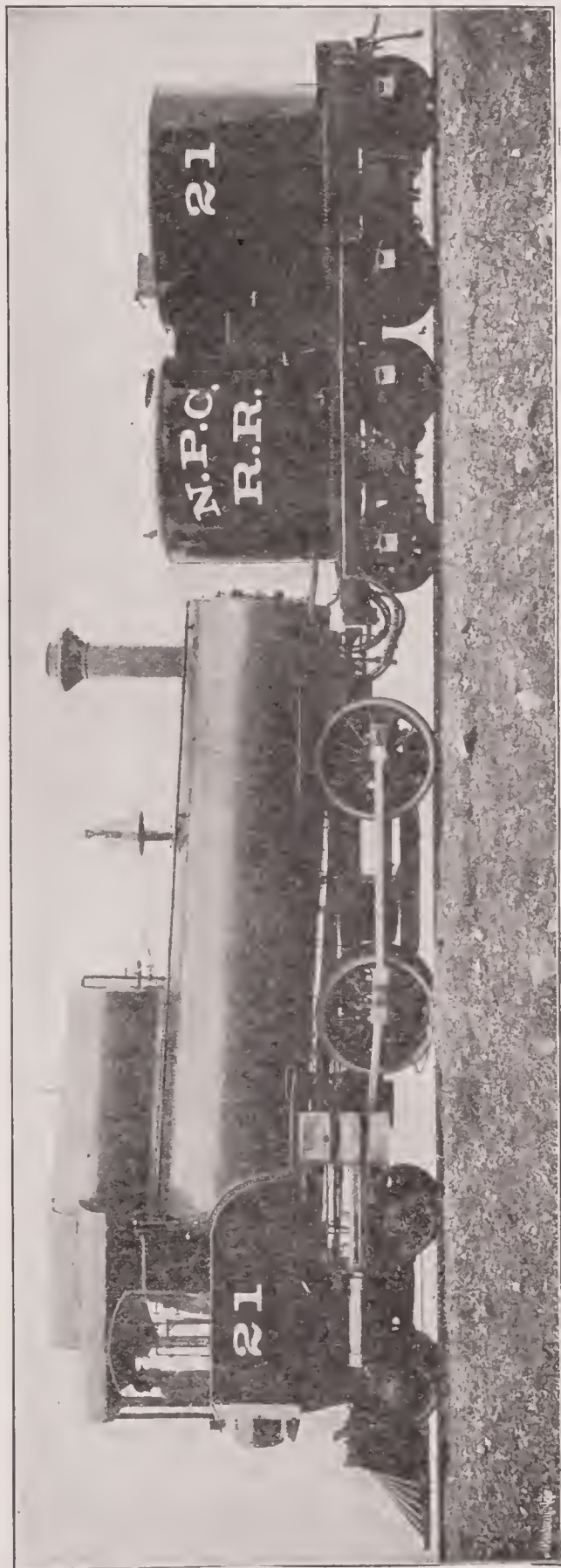


LOCOMOTIVES AND THEIR CONSTRUCTION

The modern locomotive, that draws trains of palace cars across the continent at a bewildering speed, has not many points in common with the "Rocket" and those other pioneer engines of the pioneer railways early in the century. Locomotives are getting larger and faster by a process of steady improvement in the mechanism and material. A score of great factories are busy turning out such engines for American railways, day and night, and with the great increase in railway mileage and traffic, it is almost impossible for the construction of train equipment to keep up with the demands of the roads. The locomotive trust, organized in 1901, with a capital of \$50,000,000, includes all but two of the important American manufactories. These two, however, are among the largest, and one of them is perhaps the largest of all such works in the world.

American locomotives are used the world over. In Australia, New Zealand, India, South America, South Africa, Manchuria,

Russia and Siberia, the American traveler finds himself drawn over the rails by an American engine. The American factories,



AN OIL-BURNING LOCOMOTIVE

with characteristic adaptability, turn out locomotives of every type from the monster mountain-climbing giant of 120 tons for the Rockies or the Sierra Nevadas, to the smallest engine for a mine or a sugar plantation. Making locomotives according to regular designs and patterns, so that the various parts of it are as interchangeable as the parts of a watch, these great factories can supply a demand with surprising rapidity. The greater locomotive works can turn out complete engines all the year round, at the rate of from two to five a day. If the order be for one of a regular type and size, they can deliver it out of the stock room as promptly as a grocer can deliver a barrel of sugar. For a test of speed, locomotives have been built out of the parts into the completed machine, ready for the track, in twelve hours.

It is this facility that has enabled the American builders to get into the world markets with such great rapidity, in competition with the English, French, Belgian and German builders who have hitherto monopolized the trade. Even such Australian, Russian and South African railway managers as believed the European locomotives to be superior could not overcome the temptation to buy the American machine, promised for shipment and delivered in three months or less, when the European competitor demanded one or two years. Even the English railways themselves have begun to buy American locomotives, apologetically explaining that it was promptness of delivery which compelled their choice.

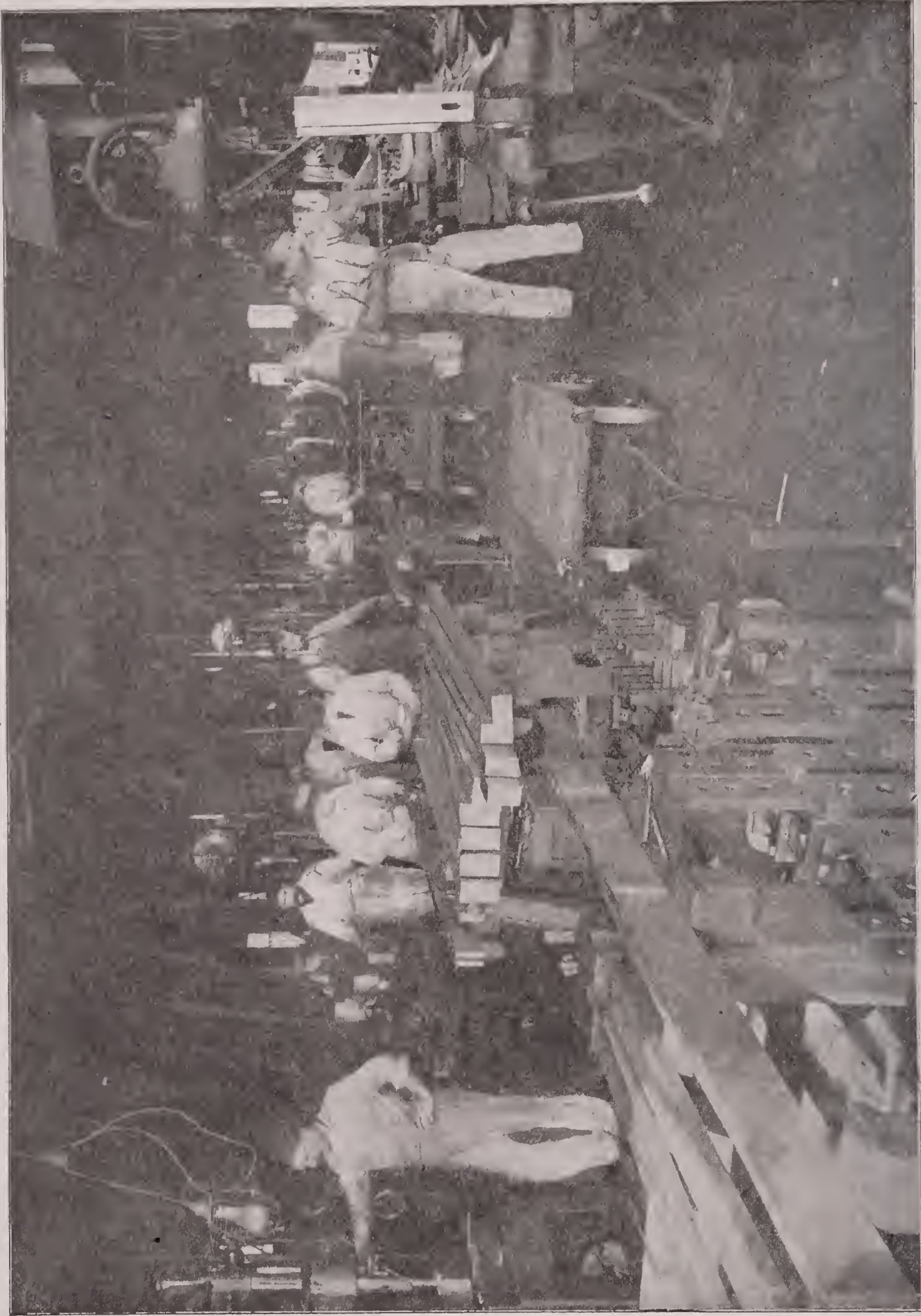
Generally speaking, English locomotives, and consequently English trains, have the better of us in speed. There are various reasons for this. One is that the English

roads early adopted the principle that there must be no surface crossings, either of other railways or of wagon roads, so that they avoid many delays and halts which American trains must make. Then, too, the English lines are invariably double-tracked, a policy which rules only on the richer American roads, in the most thickly populated districts. Then there are no such long runs in the British Isles as we have in America. The through trains between London and Glasgow or Edinburgh, a distance of not much more than 400 miles, and between London and Liverpool, less than 200 miles, are the ones making the longest runs. They have no such thing as our transcontinental lines to maintain.

The London Transport of May 10, 1901, printed figures showing the relative speed of English and American express trains. For distance up to 100 miles, the English trains average 41 miles an hour and the American trains, 42 miles. It is fair to say, though, that the average for this country is brought up by the great speed of the trains between Philadelphia and Atlantic City, otherwise it would fall slightly below that of England. For a distance of 100 to 250 miles, the average in both cases is about 40 miles an hour. For long distances English express trains average 43.3 and American 35 miles an hour. All countries have their speed records of exceptional runs and we do not fall below others in this. Speed up to seventy and eighty miles an hour is no longer uncommon, while for short distances on straight track some trains have actually achieved the marvelous speed of 112 miles an hour. It is to the American locomotive builder that the credit must be given for the machines that race over the track at such an amazing speed.



BLACKSMITH SHOP IN BALDWIN'S LOCOMOTIVE FACTORY.



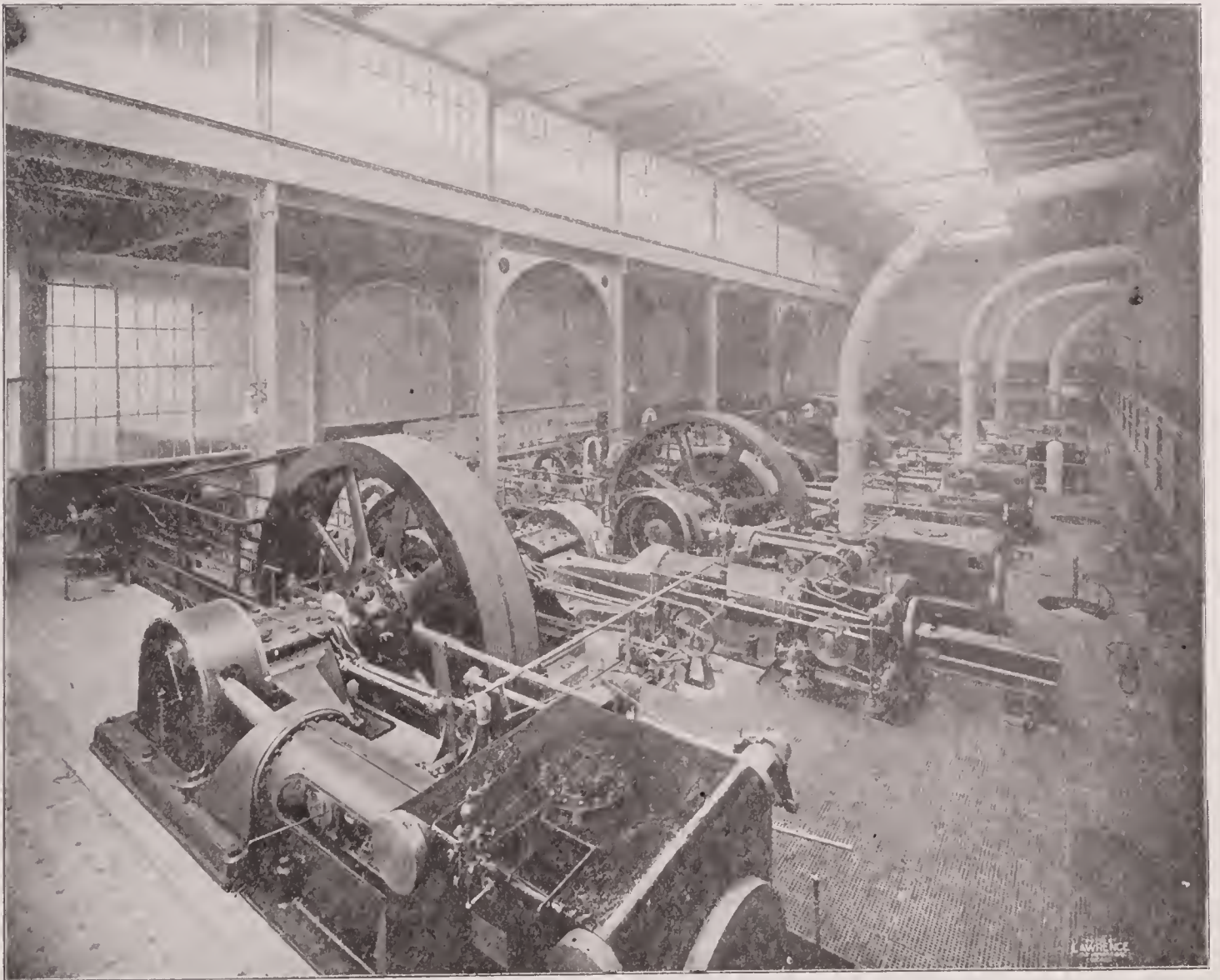
MAKING LOCOMOTIVE SPRINGS.

POWER: ITS DEVELOPMENT AND TRANSMISSION

It is a primary truth in natural philosophy that no machine can give off more power than is given to it—that something cannot be generated out of nothing. Logical experimenters have long ago given up the futile effort to discover or invent some process for perpetual motion. Instead, mechanical ingenuity has devoted its inquiry to the search for improvements in the application of power and in the mechanism of it. The most perfect engine that can be imagined would waste some of the power

naturally developed, by the loss in friction. The ideal toward which inventors strive is the reduction of friction, so that as much as possible of the power actually produced shall be used for the purpose intended, with as little waste as possible in the mechanism of the engine itself.

It is the enormous waste of power in transmission that is rapidly causing the cable-railways of city streets to be superseded by electric car lines. Electricity is one of the most economical of all powers to



INTERIOR OF A CABLE-RAILWAY POWER-HOUSE.

Showing the cables passing over the wheels which move and stretch them.



MACHINE SHOP OF BALDWIN'S LOCOMOTIVE WORKS.

transmit, because it is conducted through copper wires for long distances, with comparatively slight loss of the current. The cable system, novel and picturesque as it seemed when the idea was first put into use, requires engines and boilers sufficient

possible. This cable extends in a great circuit from the power-house, throughout the length of the line, over a large pulley, and back by another parallel track of the line, to the power-house again, where it passes over the great wheels connected with

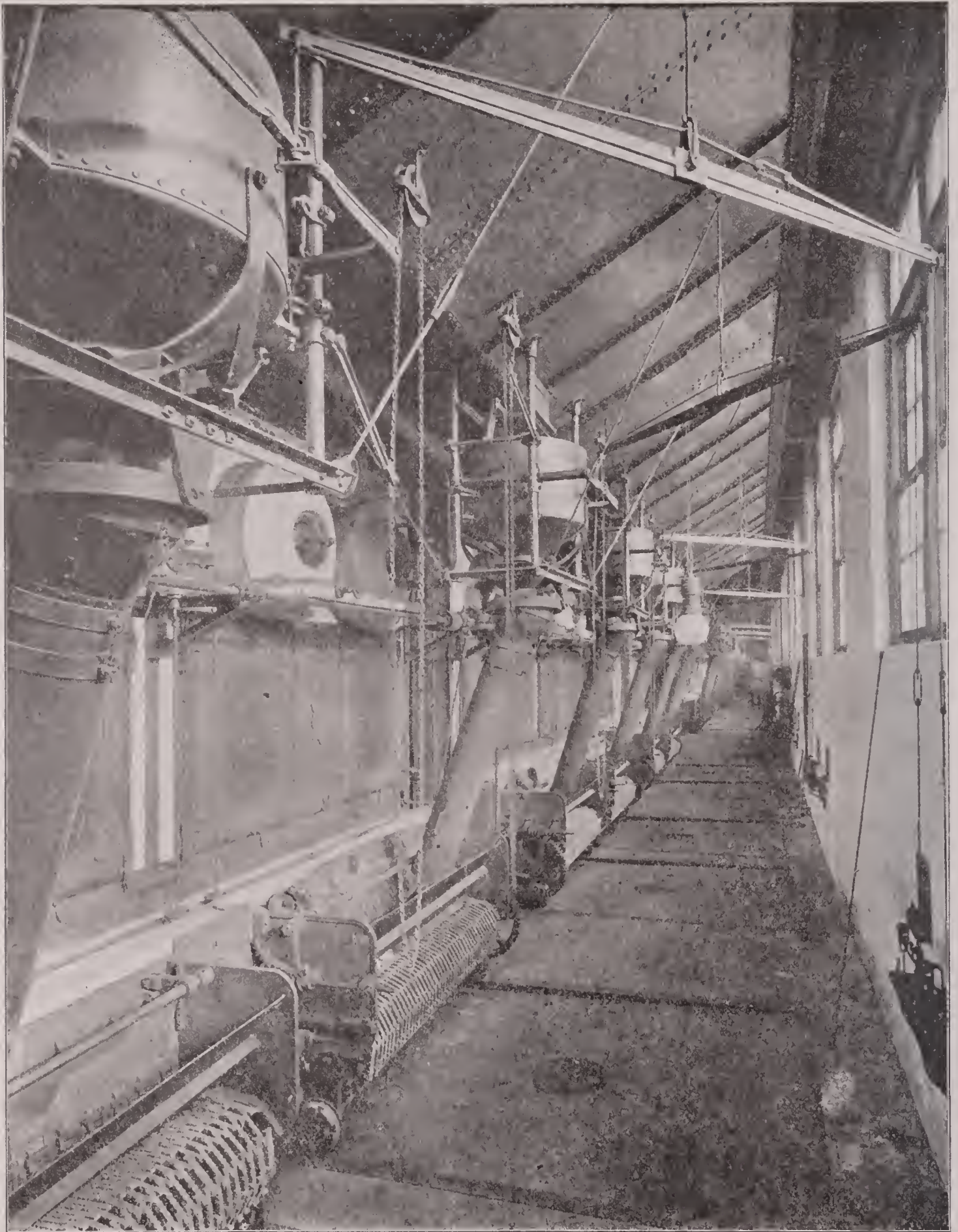


FIRING BY HAND—FURNACE ROOM OF THE CHICAGO PUBLIC LIBRARY.

to generate an immensely greater power than the actual demands of the cars in service, because so much of the power is used in drawing the cables themselves.

The cable railway of our city streets is operated as follows: In a narrow trench between the rails is a steel cable about an inch in diameter, resting on broad wheels over which it may be drawn as easily as

the engines which give it its forward motion. In order to cause the cable to move onward continuously at a regular rate of speed, an intricate device for keeping it stretched must be used, which increases the friction. It is evident that the weight of such a cable several miles long, and the friction which it generates in passing over the succession of wheels and pulleys, must



AUTOMATIC EQUIPMENT FOR FURNACES IN A GREAT POWER-HOUSE.

Coal from the chutes above is supplied to the furnaces automatically, and the revolving grate bars keep the fire in good condition.

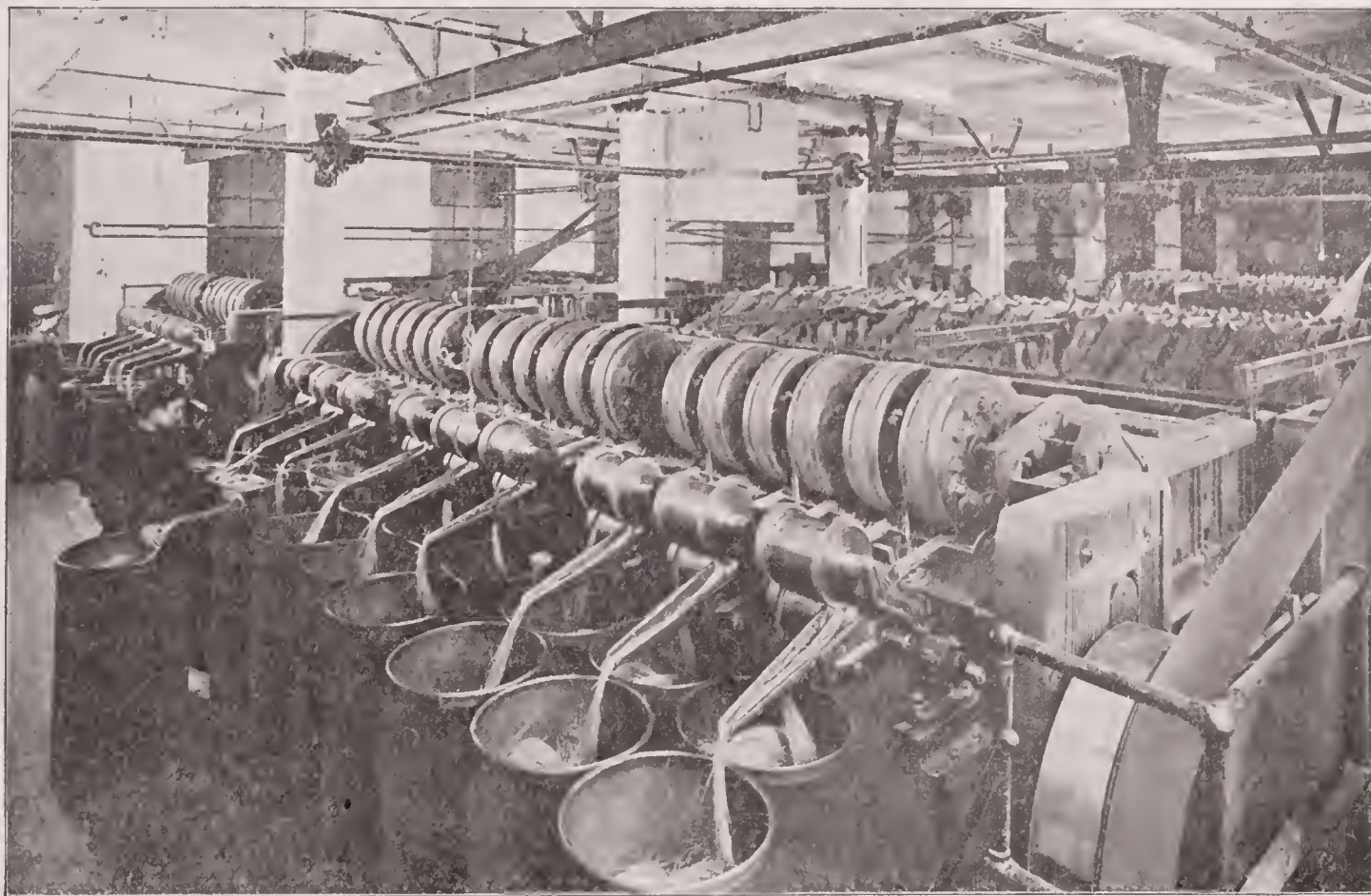
require a great engine power to move it even were there no cars to be operated.

Between the rails of the street car track, over the trench in which the cable lies, is a slot, likewise continuous. Through the bottom of the street car a clutching or gripping device extends, operated by levers above. When it is desired to start the car, the gripman moves the levers, thus grasping the cable below, and when it is desired to stop the car he releases the cable by the reverse motion of the levers. The cable itself is all the time moving. It is the identical principle by which a boy with a sled operates, in winter, when he grasps the trailing rope behind a farmer's wagon and is dragged along the ground at will. The frequent jerks and shifting strains upon the cables as cars start and stop, wear out the steel wires rapidly, and help to make the system an expensive one to operate. And yet in

many cities cable railways have proven of great value for years prior to the introduction of electric lines.

The immense power required for large manufacturing plants can hardly be realized by those who have not come in contact with such conditions. Great battleships and passenger liners in some instances have boilers and engines sufficient to develop 30,000 or 35,000 horse-power, or as much as the entire power required for all the machinery at the Chicago World's Fair of 1893. Great factories in some instances, too, require plants of almost as much magnitude. The battery of boilers such as one may see in a modern manufactory on a large scale is an impressive sight.

To some extent firemen have been eliminated in such institutions, by the invention of automatic appliances for supplying coal for the furnaces, keeping the fires in good



MAKING BINDER TWINE FROM MANILA HEMP.



HARVEST TIME ON A NORTH DAKOTA WHEAT FARM.

condition, and removing the ashes and cinders. Coal is dumped into bins above the furnaces, directly from railway tracks. Chutes carry the coal when needed from the bins to the firebox, where it is distributed by other automatic processes, and finally, automatic grate-bars, revolving upon axles at either end of the furnaces like an endless chain, keep the fires shaken down and the refuse removed as regularly and as perfectly as could be done by skilled firemen. Of course such a mechanical equipment requires the supervision of skilled engineers, but it is a great economy in labor for all that.



UP-TO-DATE METHODS IN FARMING

The methods of farming, that greatest of all American industries, have changed almost as much in late years as the methods in any of the mechanical and commercial industries. In the days when railways did not exist, and scientific farm implements had not been invented, the farmer was, indeed, but a farmer, living an isolated life,

raising his own food, and consuming his own products in large degree, in virtual independence of his fellowmen.

But now the farmer must be an intelligent business man as well if he is to make the highest success of his industry. It does not avail to buy expensive farming machinery, only to let it fall to destruction because it is given no care or protection from the elements. It is an extravagance to waste valuable pasture on inferior stock, which will bring but a low price in market, when good stock may be raised with greater ease and greater profit.

Agricultural colleges, established all over the United States, have educated thousands of young farmers in scientific methods of agriculture, with profit to themselves and their enterprise. Agricultural newspapers, circulating everywhere, form a medium of exchange of opinions and information, thus spreading the educational spirit. The Agricultural Department of the United States Government has become an immense factor in building up the agricultural interests of the country by scientific experimentation and intelligent, practical work. It is this

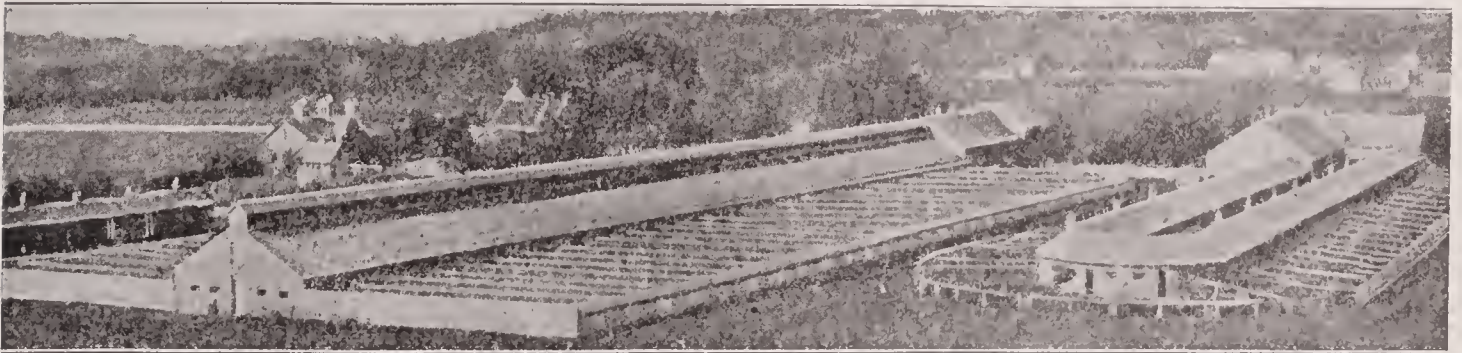


THRESHING MACHINES IN THE FIELD.

Agricultural Department that has been an active influence in preserving the forests and water supplies of the land, in reclaiming the arid and desert land in the west by irrigation systems, and in finding crops adapted for the soil.

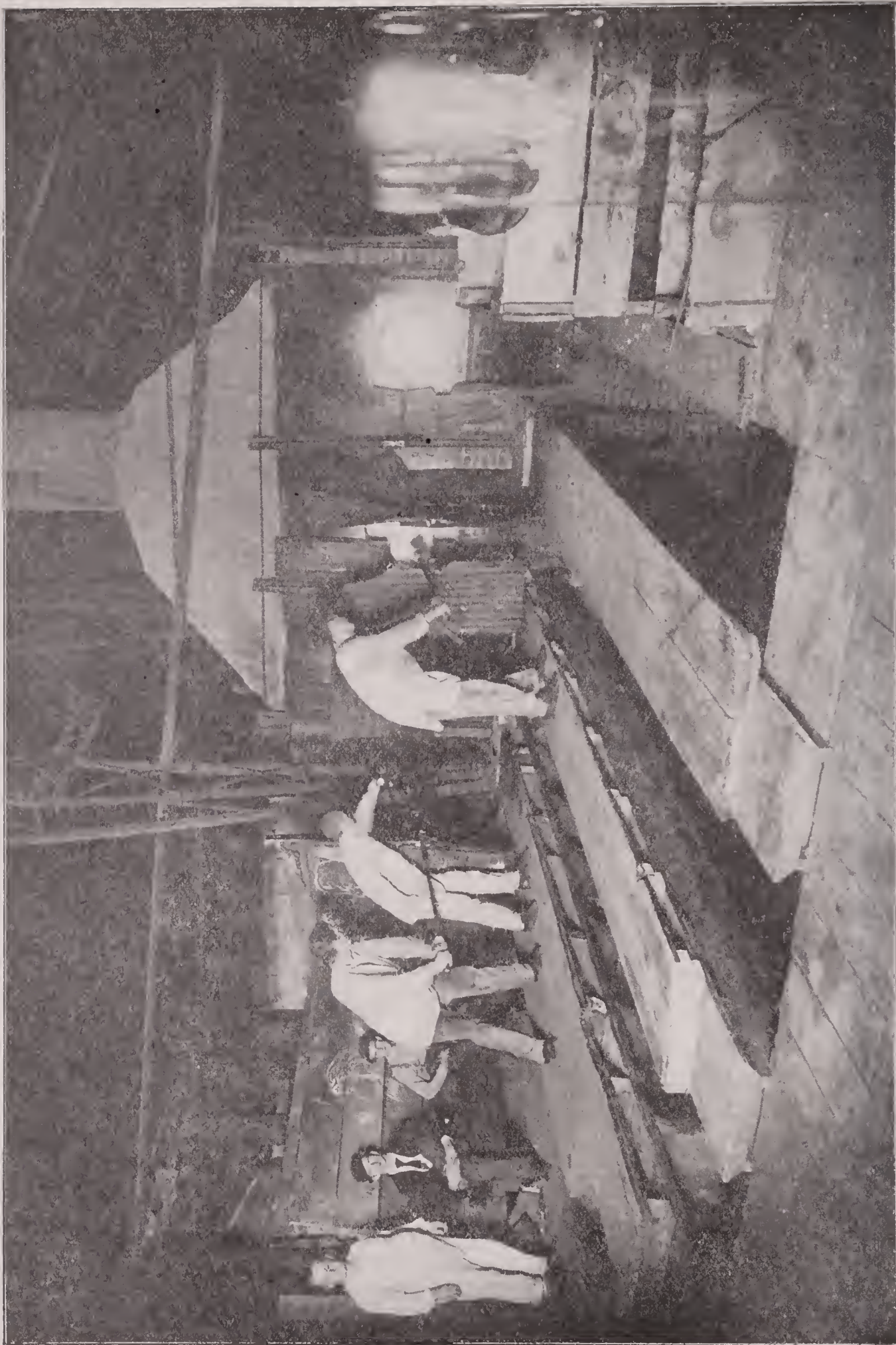
Farming and stock raising are not left to the individual husbandman who cultivates his own ground. Like the industries of handicraft, that have grown into great manufacturing enterprises, the promise of wealth in agriculture has attracted men of large ideas and large wealth. On the plains of the southwest and northwest, immense herds of cattle and sheep are grazing, owned by great corporations or energetic millionaires. In the Mississippi Valley great

farms have grown in the possession of capitalists, who conduct them as methodically as they would any other productive industry. In North Dakota, for instance, wheat farms of 20,000 acres are not uncommon. A farm of this size requires executive ability, economy of administration and attention to details in order to assure profit, just as truly as would a cotton mill or a coal mine. Batteries of reapers sweep across the wheat fields at harvest time. Platoons of harvest hands work in the fields. And yet even such an enterprise demands skill and intelligence and attention no more truly than does any one of our fertile farms, if the highest results are to be obtained from it for the owner.



THE LARGEST POULTRY PLANT IN THE WORLD, IN THE STATE OF OHIO.

Annual production 100,000 chickens, 73,000 dozen eggs.



WINDOW GLASS MAKERS AT THE MELTING FURNACES.

GLASS AND ITS USES

Without glass in its various forms, the modern household would be quite at a loss. Glass enters into so many of the essential conveniences of life, of the commonest sort, that we no longer think of it as a luxury, but as a prime necessity. Windows, dishes, bottles, lamp chimneys, mirrors and ornaments are among the first uses that come to mind, all entirely ordinary to us. And yet there are lands and tribes where glass is unknown, except as it is brought to them by traders from the outer world. The wild races of the Pacific Islands and Central Africa, like the Eskimos of the far north and the American Indians, knew nothing of glass until the white men taught them its uses. They were not slow, however, to see the value of such material, and trinkets of glass or small mirrors have been among the most effective articles of trade in the dealing of explorers with these people.

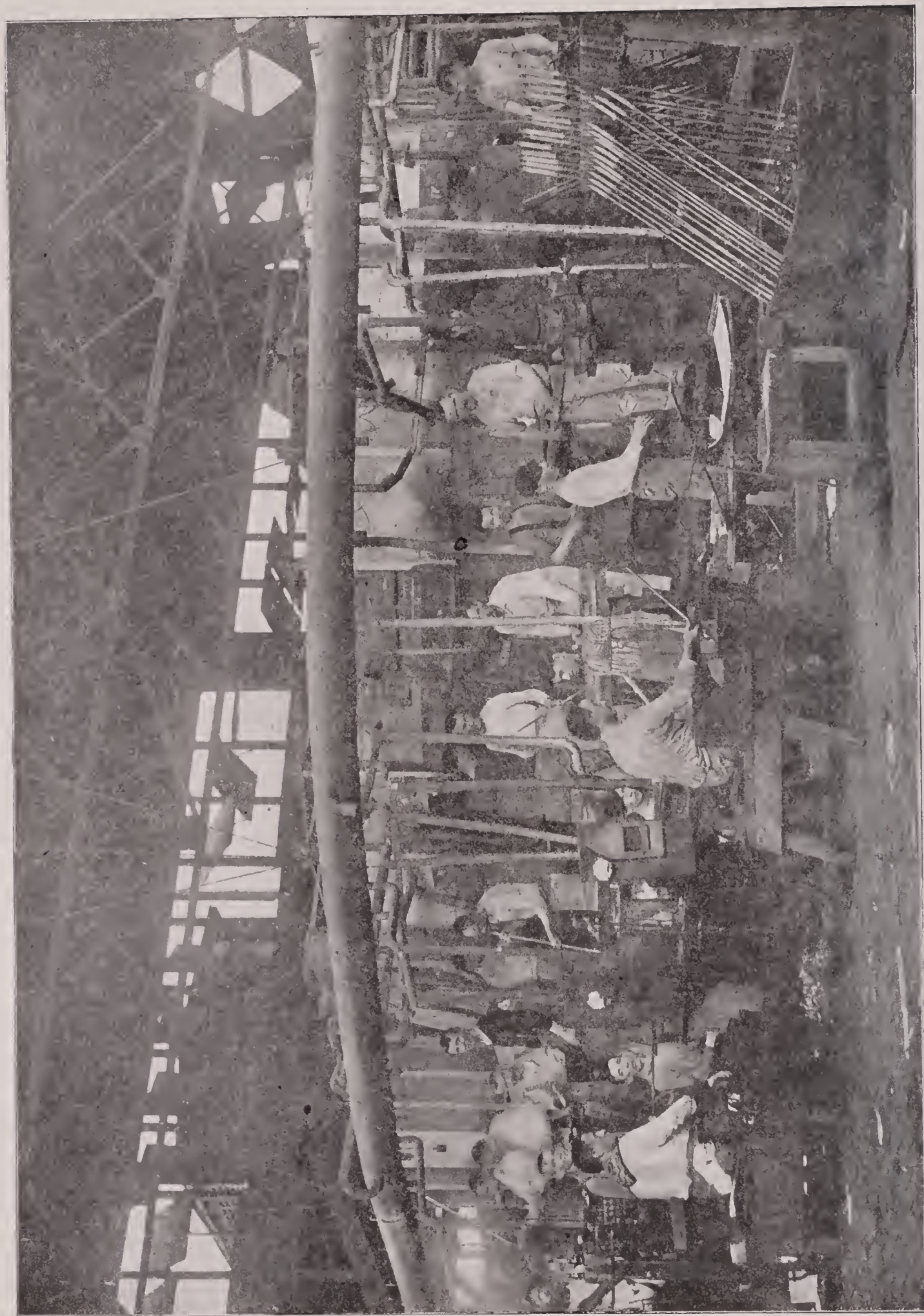
Glass was first made in England by Benedict, a monk, in 674, but at that time it was recognized only as a novelty, and not of any special value. The first use of it in England for bottles was in 1557, and in the same year the first window glass was made there. More than one hundred years later, in 1673, the first plate glass was made in Lambeth, England.

Now there is no house so mean that it does not have glass in use in many forms. The decorative value of the material is great, and there is no more interesting display of the finer fabrics of the world than can be seen in the illuminated windows of a great city shopping street, extending for miles, and forming a crystal wall behind which the choicest fabrics are displayed.

The incandescent electric light, too, requires the transparent bulb of glass to enclose it, so that we owe our brilliant light to the same common substance.

Glass factories have grown to immense proportions, particularly in the eastern states, where coal and natural gas are readily at hand for the immense quantity of fuel and the necessary mineral substances required in the manufacture. Pennsylvania and Indiana are among the states which lead in glass production. In the former state there are thirty glass factories, with an invested capital of more than \$15,000,000 and an annual value of products of more than \$9,000,000. Indiana has about twice as many factories, with a corresponding output. The employees in the glass factories of this state number 10,000 and their annual wages amount to nearly \$5,000,000.

In the countries where glass is not known, the same substitutes are still used that were employed hundreds of years ago. Sheets of mica, bits of skins and other such makeshifts are made to answer the purpose, or else the windows are left wide open. In the Arctic regions, indeed, thin sheets of ice are fitted into the walls of the snow houses, and the light penetrates through them. For bottles, wooden or earthen vessels are used. But in the civilized countries to-day, glass is so cheap and so common, thanks to the improved methods applied to its manufacture, that no one is denied its use. It is in this cheapening of the necessities that are of universal use that modern industry makes one of its most conspicuous successes.



GLASS-BOTTLE BLOWERS AT WORK.

THE WORK OF THE POTTER

From the earliest times of primitive civilization, men have made utensils for domestic use out of clay, first molded into proper shape and then hardened by heat. The most primitive races to-day make rude dishes roughly fashioned and poorly baked, and through all the progress of civilization the utility of this kind of wares has been recognized. Now some of the most artistic minds are busily engaged in creating new designs, more beautiful and more serviceable. The work of the potter and the porcelain maker has become more than a mere mechanical craft, and is recognized as an art in the best sense of the word. In the finer grades of china, pottery, porcelain and the kindred wares, European makers have excelled Americans until recent years, when the products of the Rookwood workers at Cincinnati have been recognized as worthy to rank with any in the world. French china, largely produced at Limoges from the great Haviland factory, is perhaps the best known modern ware in the American household. Wedgewood, majolica, royal Worcester, Dresden and other varieties are likewise well known in this country. The plainer products of coarser ware, either in white or decorated china, are produced in large quantities by great

potteries in New Jersey, Pennsylvania, Ohio, and some other states.

Oriental wares brought from China and Japan, are becoming better known all the time as our trade with the Far East increases. Indeed it was the country of



NIGHT SCENE IN A POTTERY.

China itself that gave to the most common ware its general title. Japanese and Chinese dishes are peculiarly attractive in their artistic decorations and their graceful form. One of these wares, known as Satsuma, is held in high esteem by connoisseurs, and collectors visit Japan for the purpose of searching for treasures of this sort.

Roughly speaking, all earthen ware passes through the same processes. The clay itself is properly mixed to the needed consistency, and then molded by hand or machine to the desired form. It is then



ARTIST DECORATING POTTERY.

decorated and glazed, after which in great ovens or kilns it is subjected to a high degree of heat, and this burning hardens the clay and makes permanent the decorations and the glaze. It is the variety of clay, the artistic ability devoted to the forming and decorating of the object, and the quality of the glaze or final finish, which regulate the beauty and the value of the product. As interest in household art has increased within the last decade, there has been a marked increase in the public appreciation of choice plastic wares, and this is resulting in a gradual improvement in what are now offered for use in the household, for decorative or practical use.

HOW PIANOS HAVE MULTIPLIED

There is no more conspicuous evidence of the manner in which all people profit by improved industrial and commercial methods, than is shown in the business of piano manufacturing. It is but a few years since a piano was a genuine luxury, to be found in the households of none but the rich, or those who made professional use of their musical talents. To pay \$1,000 for a piano meant nothing exceptionally fine in the instrument under the old regime. The piano manufacturer might be himself musician, designer, workman, business manager and salesman of his factory.

To-day all this has changed. The im-

proved methods of wood-working and metal-working devised by skilful inventors, have made possible the construction of the ordinary piano at a cost to the manufacturer of hardly one-tenth what it was a generation ago. The methods of distribution have improved no less than those of manufacture. The result is that now almost every well-to-

ago can be duplicated now or excelled for a fifth of that amount.

Piano manufactories are great industrial institutions, employing hundreds of laborers and turning out thousands of instruments a year. There is hardly a village that does not have its piano store and music teachers, and the widespread use made of



MAKING GRAND PIANOS, SHOWING INTERIOR CONSTRUCTION.

do household has its piano, perhaps not as perfect an instrument in every instance, with as true an identity as were the finest of those older ones which were all the product of skilled hand labor, and yet, it is believed, showing a higher average degree of excellence than ever before. It is true that there are still \$1,000 pianos, but they are far superior to any of the former day, while the ones that cost such a sum years

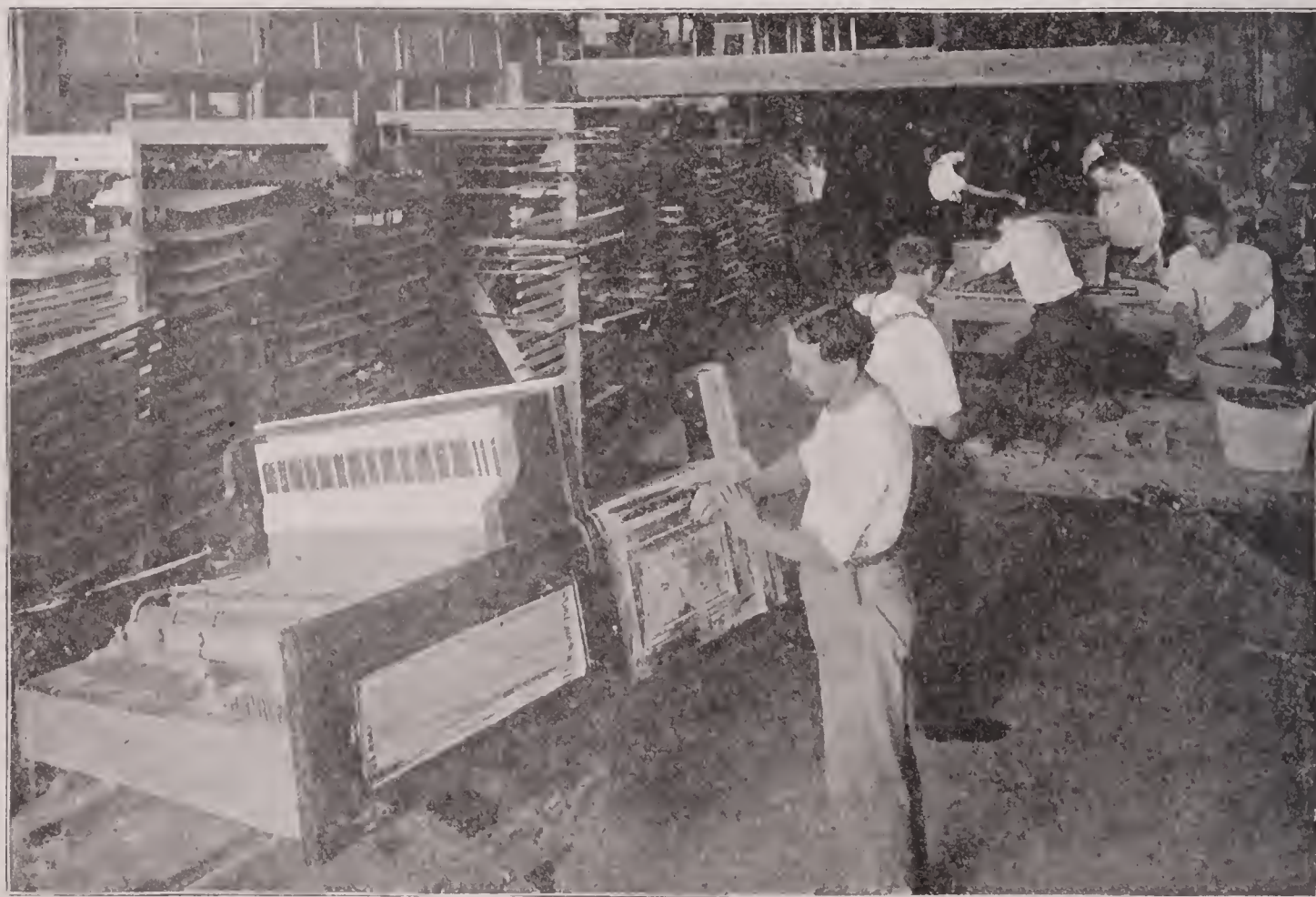
this most popular instrument, in the most enchanting of arts, is a manifest evidence of the advance of culture and prosperity in the industrial age.

Pianos, too, have changed in form as well as in price. Two generations ago the grand piano, with its great triangular bulk, was first choice. The square piano, imitating the form of the spinet or the harpsichord and the older forms of the keyed, stringed

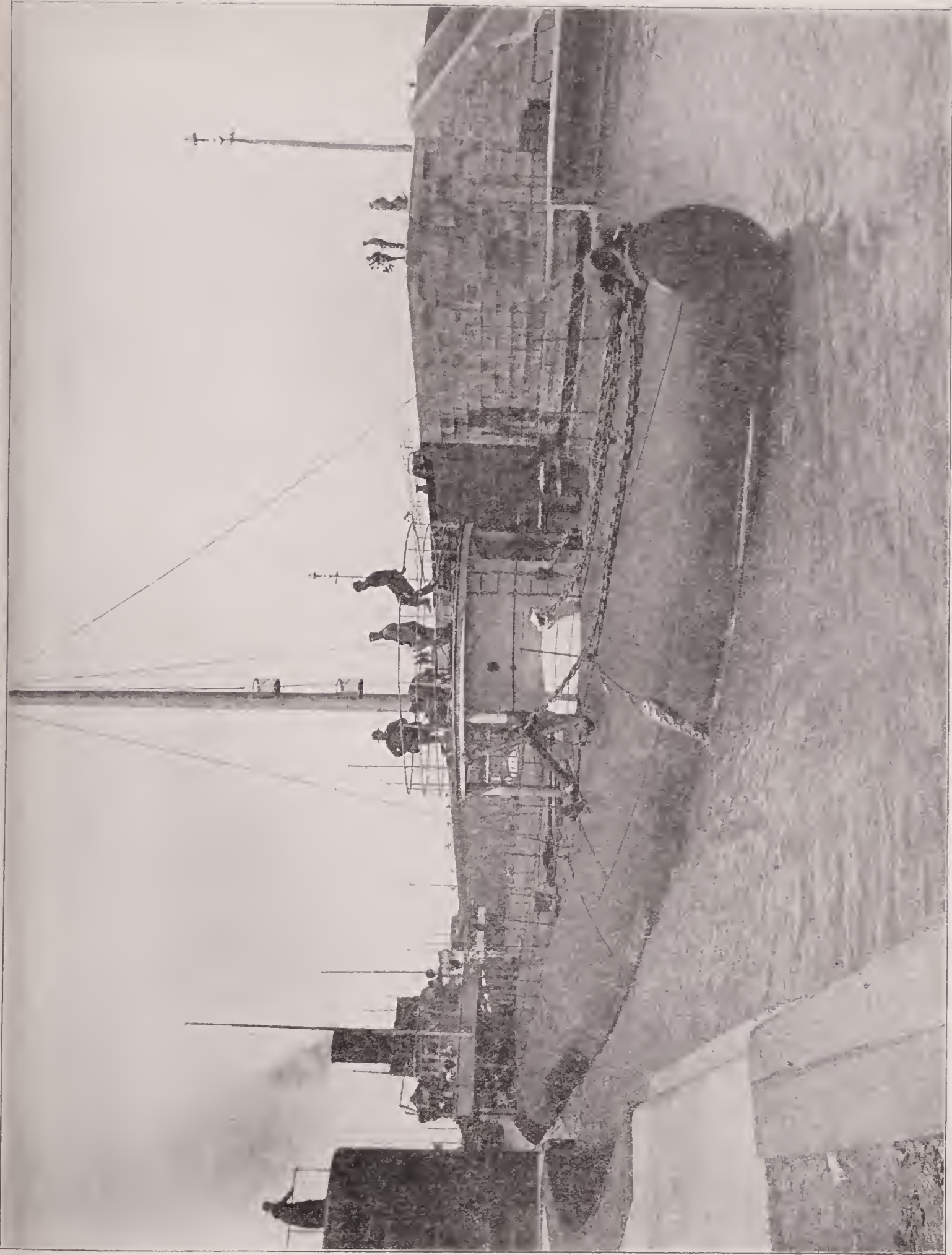
instruments, was next in favor, and was the resource of those who could not find money or room for the larger instrument. As the square piano improved it became more popular, and until twenty years ago was one commonly seen in most households. To-day the square piano has almost vanished. The upright has taken its place as a better instrument, far more convenient in form, and economical of space in the room. The grand piano with its greater size, strength and volume of tone, must retain its place for professional use, but it is safe to say that 900 out of every 1,000 pianos made in the great factories of the United States, are of the form known as the upright.

American pianos, like other American products, are finding their way far afield. Those makes which are best known in this

country as reliable and popular instruments, are recognized likewise in England and upon the continent of Europe. Some American manufacturers, indeed, in order to enter the European market to best advantage, have established selling agencies and even factories across the Atlantic, where their goods are produced and sold, to be another item in the American advance in the industrial and artistic world. Such enterprising manufacturers seek for the best materials and the best markets the world over. Good pianos must be constructed out of good materials. It is not merely the beautiful veneered and polished case, but the strength of the frame and volume of the tone, that tell the story, and in these details American piano manufacturers admit no superior.



FINISHING CASES OF UPRIGHT PIANOS.



A "WHALEBACK" IN THE GREAT CANAL LOCK AT SAULT STE. MARIE, MICH.

These peculiar craft are cargo carriers for immense shipments of ore, grain and coal on the Great Lakes, where they are peculiar sights. Among marines they are popularly known as "the pigs," on account of their shape.

THE WORLD'S BIG CANALS

For hundreds of years canals have been built to facilitate trade within the interior of countries, and to connect river systems. Some of these artificial waterways have been of great length and great commercial importance, although of late years, with the rapid development of railways, the construction of such canals has virtually ceased. The same spirit of energy, however, that once exerted itself in this manner, has now turned to greater works, and ship-canals, connecting the oceans of the world, have become the object of such efforts.

The Isthmus of Suez, connecting Africa with Asia, and separating the Red Sea from the Mediterranean, in the Eastern Hemisphere; and the Isthmus of Panama, connecting the two continents of America, and separating the Atlantic and the Pacific Oceans, in the Western Hemisphere, have long been contemplated by mariners and merchants as barriers that ought to be pierced for the sake of the world's commerce. This object at last was accomplished some thirty years ago, as far as Suez was concerned, and our own American transisthmian canal, by some



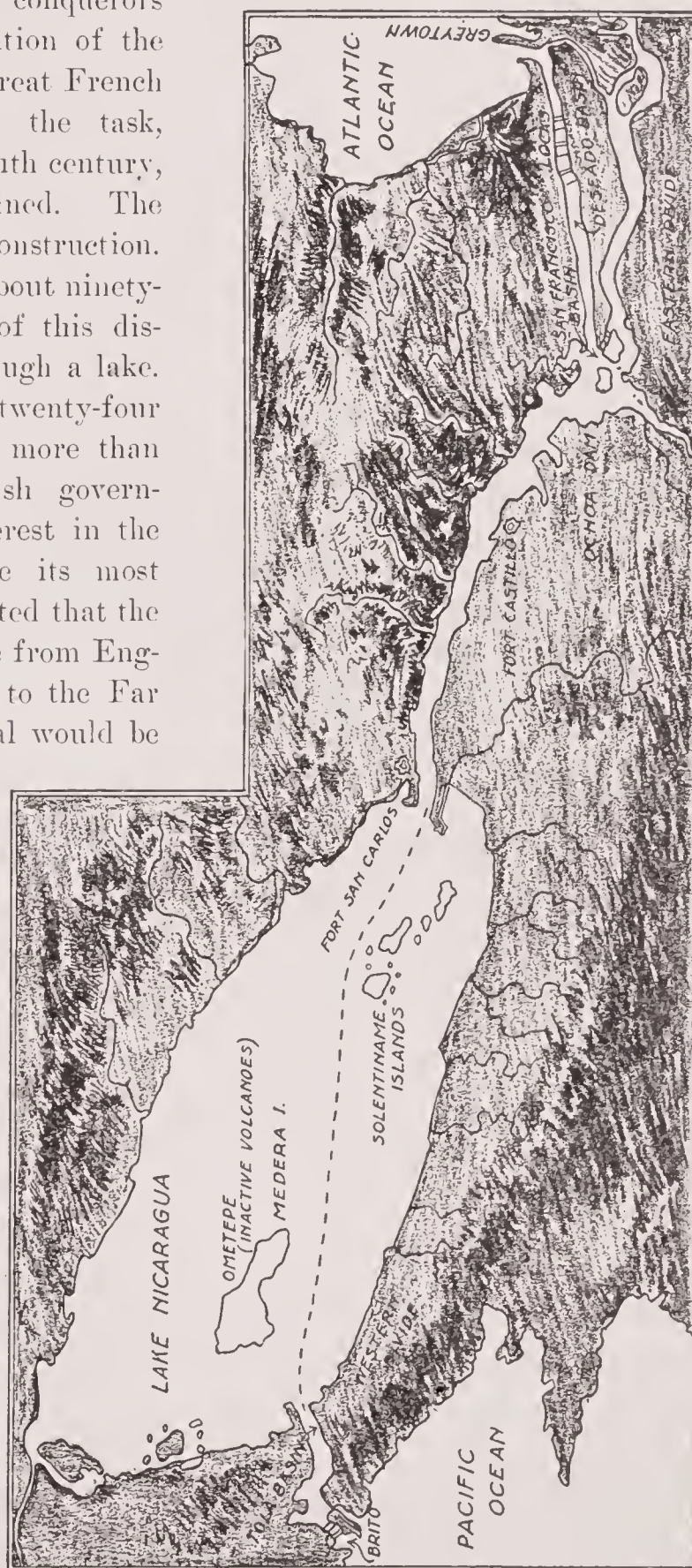
DAM AT LOCKPORT, ON THE CHICAGO DRAINAGE CANAL.

one of the rival routes, is certain to be cut and completed for traffic before many years have passed.

Egyptian kings and Roman conquerors in turn attempted the excavation of the Suez Canal, but not until the great French engineer De Lesseps assumed the task, about the middle of the nineteenth century, was any effective result attained. The canal was thirteen years in construction. It is twenty-six feet deep and about ninety-six miles long, although part of this distance was mere excavation through a lake. Steamers pass through in twenty-four hours, and the tolls average more than \$4,000 per vessel. The British government owns the controlling interest in the canal, and British ships are its most numerous patrons. It is estimated that the saving of distance in the voyage from England to India is one-half, and to the Far East one-third of what the total would be if it were still necessary to go around Africa. The saving to commerce is many millions of dollars a year.

The American canal, connecting the Caribbean Sea and the Pacific Ocean, will be hardly second in importance to the Suez Canal. The total length from sea to sea by the Nicaragua route is 183.66 miles. By this route the natural waterways of the San Juan River and Lake Nicaragua would be utilized, and the length of the artificial channel would be but 26.7 miles. The Panama route is 49.09 miles long, and of this a great

part was accomplished by the French Company organized for the purpose, which failed before completing the work.

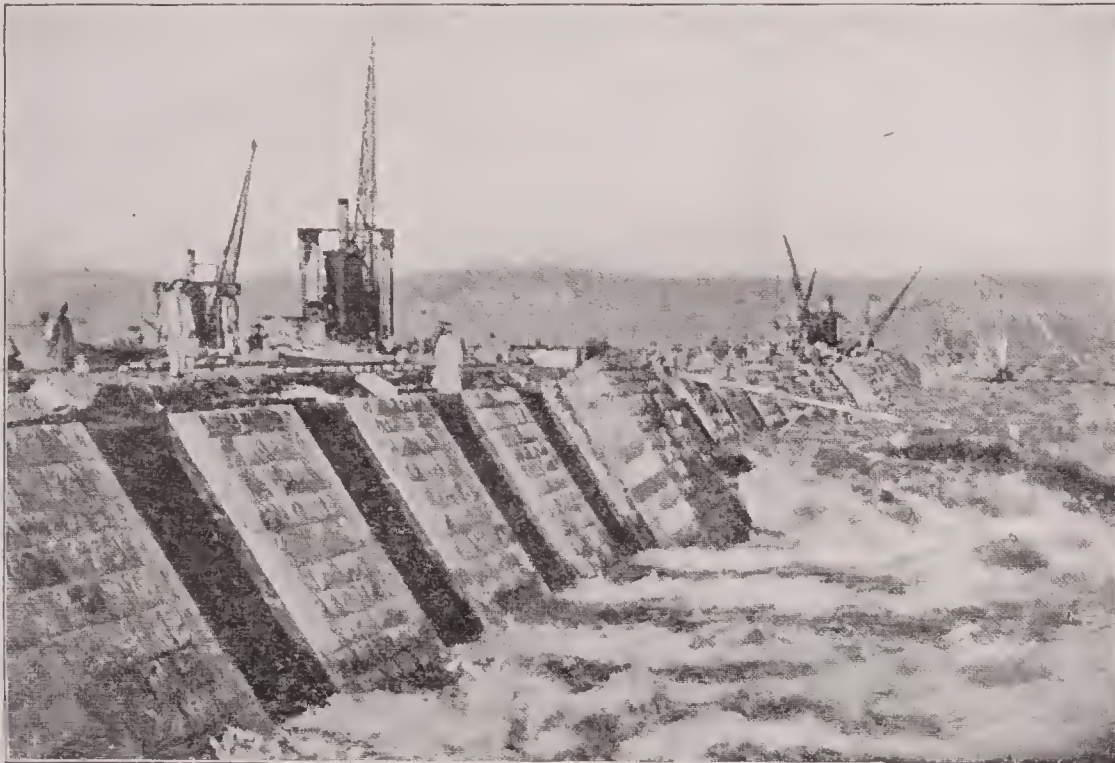


ROUTE OF THE NICARAGUA CANAL FROM OCEAN TO OCEAN.

Total length, 183.66 miles; excavation required, 26.7 miles; highest elevation of canal above sea level, 110 feet; length of high level, 153.2 miles; number of locks, 6; locks 800 feet long, 100 feet wide; depth of canal, 30 feet; least width at bottom, 100 feet; estimated time from ocean to ocean, 44 hours; length of Lake Nicaragua, 110 miles.

Surveys for the canals have been exhaustive, and every detail necessary to guide the engineer in the construction is well known. The route of the Panama Canal extends from Colon on the Atlantic side, to Panama on the Pacific, passing over twenty-five miles of river, eight miles of mountains and the remaining distance of bottom land. The estimated cost of

is obtained for ships in Lake Superior, in our own country, by a canal cutting through the great Keweenaw Point on the south shore, thus avoiding a long detour. Within the interior of many countries the canal systems play an important part in commerce. The Erie Canal, for instance, connecting Lake Erie with the Hudson River, is an important waterway across



GREAT DAM ACROSS THE NILE—UPPER EGYPT.

completing this canal is \$145,000,000. This added to the \$40,000,000 demanded by the French Company for the part of the work which they have completed makes a total cost by this route of \$185,000,000, or about \$5,000,000 less than by the Nicaragua route.

These interoceanic canals are not the only ones of great importance. The Germans, for instance, constructed the Kiel Canal from the North Sea to the Baltic, by which vessels of the largest size pass directly back and forth without needing to make the great detour around the peninsula of Denmark. A similar result

the state of New York. The Welland Canal, built by Canada between Lake Erie and Lake Ontario, enables vessels to pass around Niagara Falls and thence to the St. Lawrence River, where another succession of canal locks around the rapids of that river give access all

the way to the Atlantic Ocean. The United States Government, with its greatest of all canal locks in the St. Mary's River connecting Lake Superior and Lake Huron, at Sault Ste. Marie, surmounts the difference in level between those lakes, and navigation is therefore virtually uninterrupted between Duluth or Chicago and our Atlantic ports.

Many of the European countries have carried canal building to important proportions. All of the larger river systems of Russia are connected, and the canals of Holland, Belgium and France are famous. The Russians have been active in

Asia, too, and by the river systems which they have connected with artificial waterways, it is possible to pass with boats all the way from the Ural Mountains to Lake Baikal in the heart of the continent.

Latest of all great canals is the one built by the city of Chicago, for drainage and sanitary purposes, connecting the head waters of the Chicago River with those of the Mississippi. The former stream has been a receptacle for sewage and a menace to the city's health, because of its contamination of the municipal water supply in Lake Michigan. The opening of the canal turned the flow of the river in the other direction, and Lake Michigan now has an outlet to the Gulf of Mexico, diluting and purifying what was once a noxious stream. This canal, some thirty miles long, required seven years for construction and cost about \$35,000,000. It is deep enough for ocean vessels and some day it is believed will be a channel for a great traffic.

Long before white men came, the Chicago River was an important route for the wandering Indian tribes of Illinois. A very few miles and a very low ridge separated the headwaters of the south branch of that stream from the Desplaines River, which is a tributary of the Mississippi by way of the Illinois River, so they could drag their canoes over this short portage and continue their journey in either direction with the utmost ease. The first white explorers utilized the same route in passing between the basin of the Great Lakes and the Mississippi Valley. It is evident, therefore, that Chicago grew where it is, not by chance, but because of natural conditions which were potent in commerce and industry.

Many years ago a small canal was cut connecting these same waters, which had its

considerable commercial importance for a time. Then as the city grew, it became necessary to make some provision for the wholesome water supply required, and for the disposition of the immense quantity of sewage turned into the river. It is doubtful if any municipality ever carried to successful completion a greater undertaking than this Chicago drainage canal, or one more important in its far-reaching effects



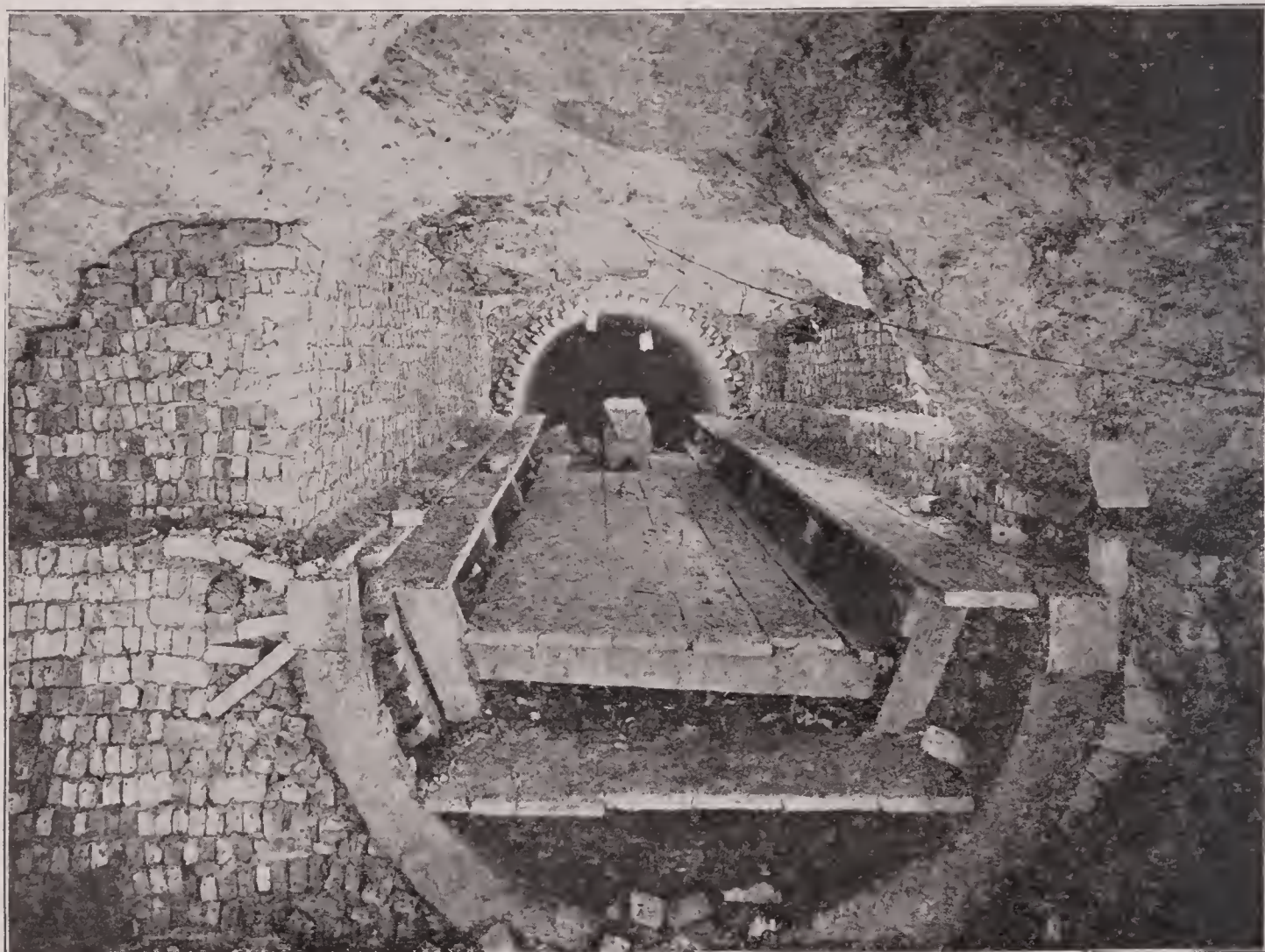
COMPRESSED-AIR DRILL, CHICAGO DRAINAGE CANAL.

on the city's health and commerce. The blue waters of Lake Michigan were left untainted by the impurities which had been poured into them, and an inexhaustible supply of this essential factor in the wholesome domestic life of a great metropolis was made uninterruptedly available.

The increased reverse current of the river scoured the banks, purified the river itself,

and improved the channel for shipping. It was promptly realized that the center-pier bridges must be eliminated, in order to leave shipping unobstructed, and plans were devised for bridges, some of the "lift" and some of the "bascul" type, leaving a broad, clear channel from bank to bank. The river was widened, the docks improved, the sharp

Rivers. It was explained by the chimerical suggestors of this undertaking, that by this route it would be possible for the Russian government to consolidate its navy, either in the Baltic or the Black Seas, without the necessity of circumnavigating Europe through the English Channel, Gibraltar and the Mediterranean. This appeared to



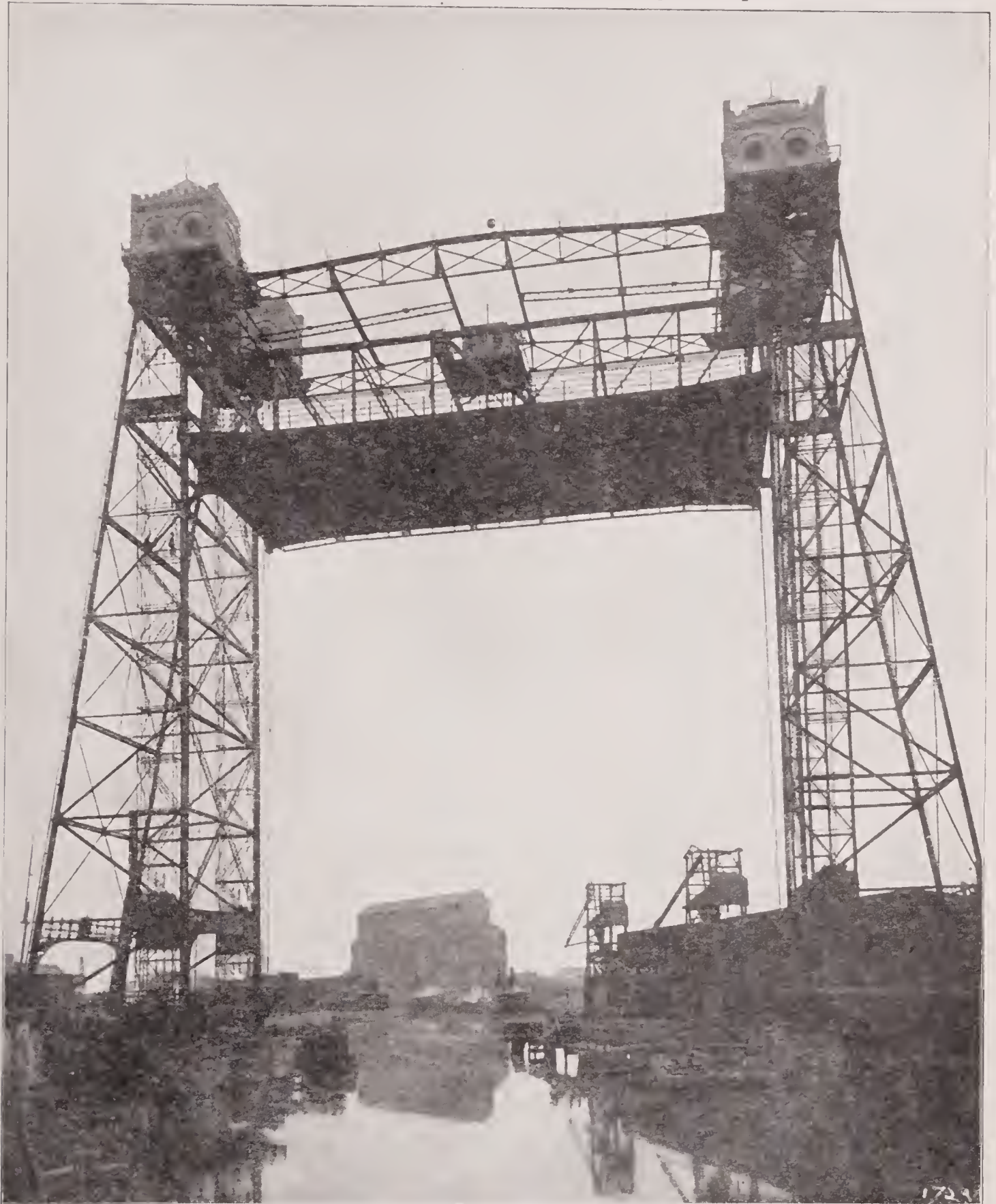
BUILDING A POWER-TRANSMISSION TUNNEL FROM A GREAT CANAL.

bends cut down, and every preparation made to accommodate an important interchange of commerce.

There is one conspicuous instance in which great publicity has been given to a visionary scheme quite certain never to be realized. This is a canal to connect the Baltic and Black Seas, across the Russian Empire, by way of the Duna and the Dnieper

them to be a sufficient reason, until it was patiently explained by the Russian authorities, who knew better, that twenty fleets such as the entire Russian navy could be built for the cost of such a canal. The distance to be canalized by this route was approximately 1,000 miles, and the rivers were so shallow that it would be necessary to excavate the channel for almost the entire

distance. It is not wise, therefore, to accept every speculative suggestion of a great engineering undertaking as actually on the road to being accomplished.



HALSTED STREET LIFT BRIDGE OVER THE CHICAGO RIVER.

The whole platform of the bridge roadway is lifted high in air like a great elevator when vessels are to pass. The bridge is operated by electricity.



INTERIOR OF A GREAT CITY BANK.

FINANCIAL METHODS OF TODAY

In addition to the production of raw material and the manufacture of it into goods for the market, and the distribution of these goods by railways and great mercantile concerns, the industrial world is compelled to recognize a multitude of middlemen, whose functions are of the highest importance in the present business organization. These are the financial concerns and agencies of various sorts that deal in credit, providing money when it is needed, at a profit to themselves, and in general sharing in the processes of sale and collection. Roughly speaking, banks, chambers of commerce, boards of trade and stock exchanges in-

clude the men who control these details of industrial activity. They are strongest in the financial centers and great markets of the world, where business concentrates, and they are a factor always to be reckoned with.

Banks, generally speaking, are purely financial in their dealings, affording places for the deposit of money, and lending to their customers at interest. Chambers of commerce and boards of trade operate chiefly in commodities, such as grain, wheat, cotton, coffee and the like. Stock exchanges deal in financial securities, such as stocks and bonds of railways, mining



BANK OF ENGLAND AND ROYAL EXCHANGE, LONDON.

This is the financial center of the world. The Bank is the building on the left and the Exchange is the pillared structure on the right. The Mansion House, residence of the Lord Mayor, is opposite the Bank, not shown in the illustration.

companies and other corporations. Owing to the intimacy of trade and communication between the various markets of the world, the importance of these controlling organizations continually grows, and the condition of the market in any financial center responds rapidly to influence throughout the world.

banks are gaining in this country at a startling rate of speed. At least one bank in New York City has a capital of \$25,000,000 and a surplus of \$15,000,000, while two others in that city and one in Chicago exceed \$15,000,000 in capital and surplus. With deposits in their vaults ranging from \$50,000,000 to \$125,000,000, and connec-



"WALL STREET," THE FAMOUS NEW YORK STOCK EXCHANGE.

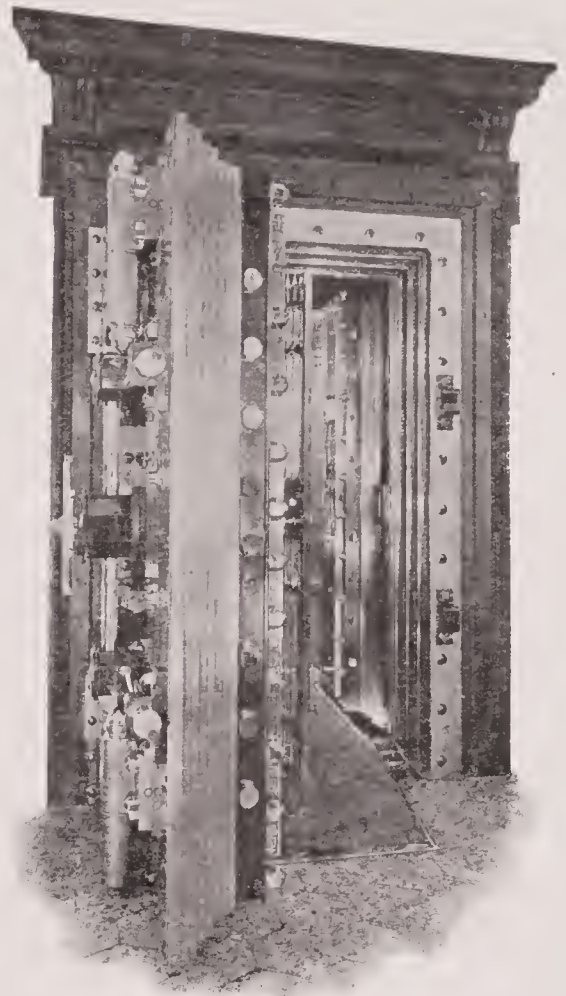
This was the last photograph taken of the old Stock Exchange where so many financial "panics" have occurred, before it was torn down to make way for a splendid new building.

Banks are growing in size and influence with great rapidity, the tendency being toward the consolidation of such institutions in cities, with immense capital and far-reaching connections. The Bank of England, the Bank of France, the banking houses of the Rothschild family, and others in Europe, far surpass anything we have in America. Along with the growth of trusts and industrial organizations, however,

tions with smaller city and country banks all over the United States, it is apparent that the financiers who control such great institutions exert wide influence upon the business affairs of the nation. The significant thing in this enormous capitalization of city banks, which was not even dreamed of five years ago, is that it is a reflection of the gigantic strides of America toward the commercial supremacy of the world.

New York looks forward to the proud eminence of being the financial center of the world. This greatest of American banks has been an important factor in many of the recent colossal combinations or "Morganizations," engineered by J. Pierpont Morgan and other financial giants.

The method of trading that has grown up in boards of trade and stock exchanges is full of technicalities that puzzle the visitor. In an excited state of the market, the confusion is bewildering. Traders are shouting their sales and purchases into each other's ears, or frantically waving their hands high in the air, with one or more fingers extended to signal what they mean, according to a code that is well understood. Of course the actual transfers of stocks or provisions are very great, and still this phase of the business is far exceeded by mythical dealings in "futures." When a sale is made for a future delivery at a given price, this does not at all imply necessarily that the goods are to be delivered. Instead, when that date comes around, if



BANK VAULT DOOR OPEN.

the actual market price of the commodity is higher than the contract price, the one who



"THROGMORTON STREET," THE LONDON STOCK EXCHANGE.

This photograph was taken during the British war in South Africa, on a day of great public excitement.



THE CHICAGO BOARD OF TRADE.

The octagonal rostrums, with steps leading to them, have depressions in the center, at the floor level, and these are the "pits" which figure in all accounts of trading.

has sold simply pays to the buyer the difference between these two figures. If the contract price is lower than the current market price, the buyer pays the difference to the seller, and the deal is thus closed.

It is this condition that justifies the familiar charge that such deals are but bets as to what the price will be at a certain time in the future, the loser to pay his loss. "Puts" and "calls" are privileges to deliver or to claim a certain commodity at a certain price in the future. The one buying the privilege to deliver to another, or to demand from him under such circumstances, is in effect betting that the price will fluctuate in the interval in such a way as to give him a profit.

Traders are divided into two general groups known as "bulls" and "bears." Any man holding a commodity and wishing to sell it, or holding a future privilege to call for it at a fixed price, naturally desires to see the price of this commodity rise, and devotes his energy to hoisting the price in any way possible. He is therefore known as a bull. The bear, on the other hand, is the one who wishes to buy a commodity, or who has an outstanding contract to deliver at a fixed price at a future time, that which he has not now in hand, and his interest therefore is to depreciate the price. It is this condition that makes the eternal quarrel between the two elements on the market, although, of course, they are con-

tinually shifting in identity as their trades change.

There is little essential difference between the so-called "bucket shops" and the boards of trade themselves. The former make deals of smaller size, and probably a smaller percentage of their trading is for actual delivery of the commodity dealt in.

"Margins" are the sums of money deposited with a broker to guarantee a given trade. If the commodity were bought outright, of course, the whole purchase price would have to be paid, but when it is merely bought for speculation, to close the trade whenever the price justifies, that is not necessary. If, for instance, a buyer instructs his broker to purchase 10,000 bushels of wheat, he may deposit \$200 to guarantee the trade. The purchase of the wheat is entered on the books, and as long after that as wheat rises on the market, the purchaser is making a profit and could sell out again, or close the deal at any moment, withdrawing his deposit and the increase. If, however, instead of rising, the wheat falls in price, as soon as it has fallen two cents a bushel, the \$200 deposit is exhausted, and the margin is "wiped out" or lost. In the event that the purchaser wishes to protect his deal still further, he may continue to deposit margins as long as he likes, to see them continually lost if the price continues to fall. There are a multitude of other details and technicalities in stock exchange and board of trade dealings, but these are the essential ones and should be sufficient to show that such institutions offer little profit to the stranger, who is not on hand to direct his own investments. Many systems have been invented by which to "beat" the markets, but no successful one has been devised.

WHERE OUR MONEY IS MADE

The United States Government, under the constitution, reserves for itself the right of issuing all metallic money for the nation, and the great mint at Philadelphia is a place of peculiar interest to every curious visitor who wishes to see how money is made.

When the bullion is received at the mint from the mines and other sources throughout the country, it is melted in crucibles and molded into ingots not unlike pig iron or steel right from the foundries. In this form copper, silver and gold do not show their value, but appear uninteresting in the extreme. Repeated processes of refining and alloying to the proper degree of fineness gradually bring the precious metals



BANK VAULT DOOR CLOSED.

into more sightly form, although it is long before they take on the final polish.

For silver dollars, for instance, long strips of the metal are molded to the proper thickness and proper width. They are passed through a press which first stamps out discs of the metal of the proper size and shape for the finished dollar. These discs undergo a polishing process, and then great hoppers of them are placed over the coining machines, from which they trickle out a stream of shining dollars. A single motion of the machine turns out the coin from the discs. Two dies, one for each side of the coin, meet with irresistible force and stamp the designs upon the metal, while at the same time the milled edges are formed by the encircling pressure. The coins then

are given their final polishing, after which ingenious automatic scales weigh them, separating the ones that are too heavy or too light from the perfect ones, to be returned to the melting pot for another coining process. But few people are so indifferent to the enticements of money that they fail to be impressed at the sight of gold or silver dollars, pouring in a continuous stream from the coining machines in the mint.

The old mint at Philadelphia, from which hundreds of millions of dollars of coin were turned out during the nineteenth century, has been supplanted by a splendid new building, equipped with the most modern machinery, and doubly effective for the convenience of its arrangements. There



THE NEW UNITED STATES MINT AT PHILADELPHIA.

are mints also at Denver, New Orleans, and San Francisco, and government assay offices at New York, St. Louis, Deadwood, Helena, Boise, Carson, Seattle and Charlotte, N. C.

The assay office is practically an outside agency for a mint. It receives the bullion, ascertains and pays its coinage value less any bullion charges that may be made for the service, and ships it to one of the mints. The equipment and organization of a mint

age, is received and coined without charge. If it contains base or other metals which must be removed, a refinery charge is made, and if it is above the standard an alloy charge is made. The law provides that these charges shall equal, but not exceed, the cost of the service. The total number of pieces of coins struck by the mints of the United States in 1901 was approximately 185,000,000, and the value about \$140,000,000.



HAULING INGOTS OF SILVER BULLION IN THE PHILADELPHIA MINT.

are expensive, and it is cheaper to concentrate coinage operations in a few institutions than to multiply mints. An assay office renders practically the same service to the mining industry that is rendered by the mint. The New York assay office receives the bullion upon precisely the same terms as a mint, but the others make a special charge of one-eighth of one per cent in addition to mint charges.

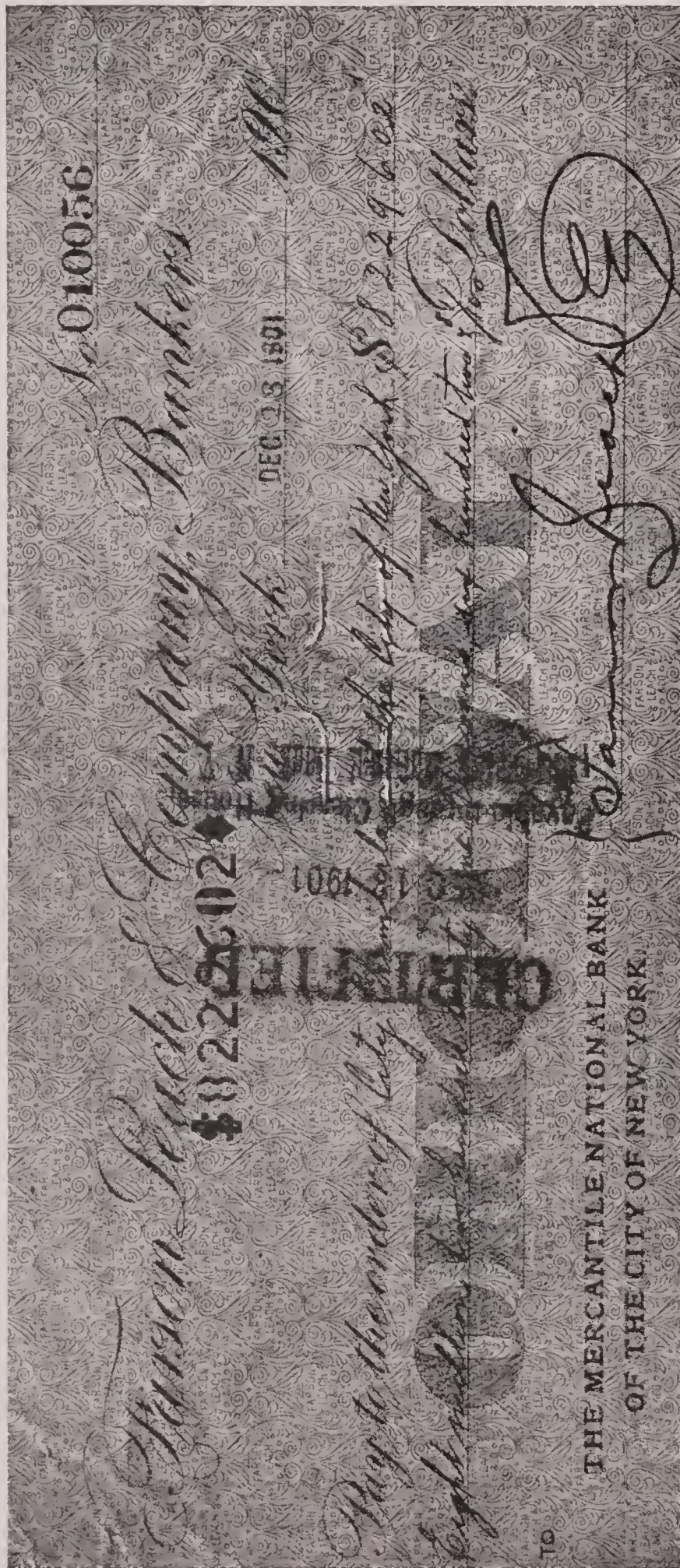
Gold bullion that is of standard fineness, and requires no treatment to fit it for coin-

This exceeded any record before made by any government.

✻ ✻ ✻

EIGHT MILLION DOLLARS IN ONE CHECK

The largest financial transactions are not settled by a transfer of coin, or even paper money, from hand to hand. The very weight and bulk of the money required makes that impossible. Instead bank checks are used for settlement of great obligations,



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MADE FROM PHOTOGRAPH OF ORIGINAL CHECK FOR OVER EIGHT MILLION DOLLARS THAT WENT THROUGH BANK AND WAS PAID.

and the money called for can be transferred at will from bank to bank, according as the customer desires. The check reproduced herewith is believed to be the largest ever drawn in any American transaction, if not in the world. It calls for the sum of \$8,229,602.81, and was made by the Chicago banking firm of Farson, Leach & Company, in their New York branch office, in settlement of a purchase of municipal bonds issued by New York City. The check was passed through the New York Clearing House, where the daily balances are adjusted between the banks, and it took the usual course of business papers.

If the amount of money represented by this check were paid in silver dollars, it would weigh about 300 tons, and would require a train of fifteen heavily loaded freight cars to carry it. In gold it would make eighteen tons, and one car would be sufficient. It is hard to conceive such a sum of money. Invested in ordinary dwellings, at an average cost of \$2,000 each, this is enough money to build 4,100 houses, or as many as comprise the ordinary American city of 20,000 inhabitants.

ORANGE GROVES AND THEIR PRODUCTS

Thanks to the semi-tropical climate of our favored southern states, particularly Florida and Southern California, we are enabled to have a current supply of luscious fruits and vegetables of subtropical character which only a few years ago were considered as genuine delicacies of some rarity, instead of being commonly found in the markets as they are now. In addition to these newly developed regions of our own country, commercial enterprise of late years has placed Central America, Jamaica and certain others of our neighbors in the Carib-

bean Sea under tribute, for still further tropical delicacies, and now the volume of trade in such foods has become very great. Bananas, for instance, come to us in immense shipments, the year round, from Honduras by way of New Orleans, and from Jamaica by way of Philadelphia and Boston. Our pineapple supply is chiefly from the West India Islands, although Florida sends an increasing crop northward every year, and the Hawaiian Islands have begun to contribute their quota by way of the Pacific coast.



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PICKING ORANGES IN A CALIFORNIA GROVE.

The orange production of the country is multiplied many times since the possibilities of California began to be realized. Florida still supplies large quantities of the choicest fruit from the Indian River orchards, but the area devoted to the industry is not increasing greatly. In California, however, the increase is very rapid and even young readers can surely remember within their own knowledge a time when the golden fruit was by no means as commonly seen in every town and village as it is now. Although we usually associate the orange groves of California with the southern part of the state, as a matter of fact they are by no means confined to this vicinity. Central California indeed, from Sacramento north, has some of the choicest and largest of the orange orchards, and the production in that part of the state rivals if it does not exceed, the more famous regions around Los Angeles and San Diego.

It is difficult to imagine any horticultural scene more beautiful than an orange grove in full bearing. Citrus trees have a foliage of a peculiarly brilliant green and the golden fruit itself, glittering among the leaves, brightens the picture with a vivid color which justifies the admiration and interest always excited. Oranges are shipped east from California every day in the year, the smallest number of carloads in any one day being perhaps half a dozen, in the months of September and October. The annual harvesting of the crop begins about the middle of November, and is at its highest from January to March. In those months the average shipment is over 250 carloads a day, and the industry affords employment to a small army of pickers and packers. It is one of the corner-stones of the prosperity of the state. The product

averages about half a carload to the acre of bearing trees throughout the state, and as the trees grow older this average increases. The groves vary in size from ten acres to forty, the latter area being all that one man can take care of with the help of one farm hand. Less than ten acres can not be depended upon for a sufficient income, though there are instances of five-acre tracts that have, through careful cultivation, yielded large returns. The land costs all the way from \$100 to \$300 an acre, bare of trees. An orange orchard in good bearing is worth approximately \$1,000 an acre, and the chances are that it will have cost its owner a large part of that sum, in investment, interest and period of waiting. But the returns from the industry justify that high valuation. The majority of the well-managed orange orchards produce a profit annually of from \$125 to \$175 an acre.

The citrus fruits were introduced into California more than a century ago, by the Spanish mission fathers who brought them from Mexico and Spain. If they could return to-day to the scene of their labor, they would see a wonderful change in the industry. Cultivation for export was not attempted until early in the seventies, and even as late as 1886 the total export product was only 150,000 boxes, or 500 carloads. In the years from 1885 to 1895 a vast amount of planting took place and the trees are now all coming into fruitfulness. The crop of 1900 was 18,000 carloads, or 6,000,000 boxes, of which about 85 per cent was oranges and 15 per cent lemons. The oranges are largely marketed through mutual associations, formed to share the expense of maintaining agencies in the eastern markets, and to obtain the most

favorable prices for them. These associations are organized in the different orange-producing districts, and they have warehouses where the crop is received, sorted and packed for shipment. The wagon-loads of fruit are poured into hoppers from which inclined tin troughs extend in various directions. The oranges are sorted by size, automatically, as they are shaken over the hoppers and fall through holes into the troughs, much as coal is screened for ship-

ment. The small oranges roll gently down the incline to one box, those of the next size to another, and so on till the sorting is completed and each box is filled with fruit of uniform size, carefully wrapped by the deft-fingered girls who find profitable employment in this work. Thence the boxes are delivered to the railways for shipment, and ultimately they find themselves in the town and city markets throughout the country, ready for any purchaser.



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SORTING AND PACKING ORANGES FOR SHIPMENT.



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ALLIGATORS ON THE INDIAN RIVER, FLORIDA.

OLIVE ORCHARDS AND THE OLIVE INDUSTRY

There is no country which rivals the United States in its resources and climate. Now that we have incorporated in our territory, or affiliated by close personal relations, so many islands of the Pacific Ocean, we may truthfully say that the sun never sets on our possessions and that within our own domain we can provide for every want of mankind. In the West Indian Islands which we have acquired, in Samoa, in the Hawaiian Islands, and in the Philippines, can be produced every tropical product that has a commercial value. Hereafter, we

may grow our own spices and tropical fruits, our coffee and our hemp, and a million other peculiarly tropical productions which are not produced commercially in the United States proper.

But here in our own country, between the Atlantic and the Pacific, from British America on the north, to Mexico on the south, we have such a variety of resources from the soil and the mountains, from the forests and the plains, as to make us almost absolutely independent of the world markets, if by chance we should be isolated



ITALIAN PEASANTS MAKING OLIVE OIL.

After the olives are crushed, they are placed in circular bags and squeezed in the press, into a large vessel. Next the oil has to be placed in stone jars. During this process, which is begun by making the sign of the cross over the oil, no one is allowed to speak.

from them. Although no part of the United States is actually within the tropics, yet in Southern California and Florida the balmy climate makes possible the cultivation of most of the more important tropical plants. So it is that by varied climate, elevation and conditions, we have been able to develop industries and productions out of the animal, mineral, and vegetable kingdoms, in peculiarly favorable proportion.

Southern California has been called by the eminent writer, Charles Dudley Warner, "our Italy," and in Southern California grow many of the products which are recognized as characteristically Italian. Strange as it may seem, the largest olive orchard in the world is located here. The olive groves of the Mediterranean are finding a rival in this favored land, and the industry is recognized in California as one of the most profitable of the undertakings now under way. Only in a limited area of Central and Southern California, New Mexico and Arizona, can the olive be produced in this country. It is quite certain, therefore, that there will not be an over-production.

It is a proverb in Italy, that he who has an olive orchard has a perpetual fountain of wealth. It is more than 100 years since the first of these orchards was planted by the Spanish mission fathers of California, who did so much to influence the early industries and life of that state when it was a part of Spanish Mexico. The success of their olive trees proved the adaptability of the climate, and ever since that time the industry has been steadily increasing. The olives grown in California produce from twenty-four to thirty-one per cent of oil. They are richer and more palatable when pickled than are the imported green olives

from Italy, and the demand for ripe olives is continually on the increase. The older the olive tree becomes, the more valuable it is to its owner, because of its prolific bearing. The wood of these trees is highly prized by cabinet makers for it is exceedingly hard and susceptible to high polish. It is greenish yellow in color, with black, cloudy spots and curving veins.

The great orchard in question is about twenty-five miles north of Los Angeles. There are 1,200 acres of olives in the orchard, 100 trees to the acre. About \$225,000 has been expended in the improvements, and here in the grove is a factory with all the machinery necessary for marketing the whole of the product. They may be pickled and sold for table use, or the oil may be extracted. It is estimated that each acre of such an orchard will produce 2,000 gallons of olives this year. These will make 250 gallons of oil, which at \$2 a gallon will bring the owner a revenue of \$500 an acre. As the trees increase in age, this product is increased.

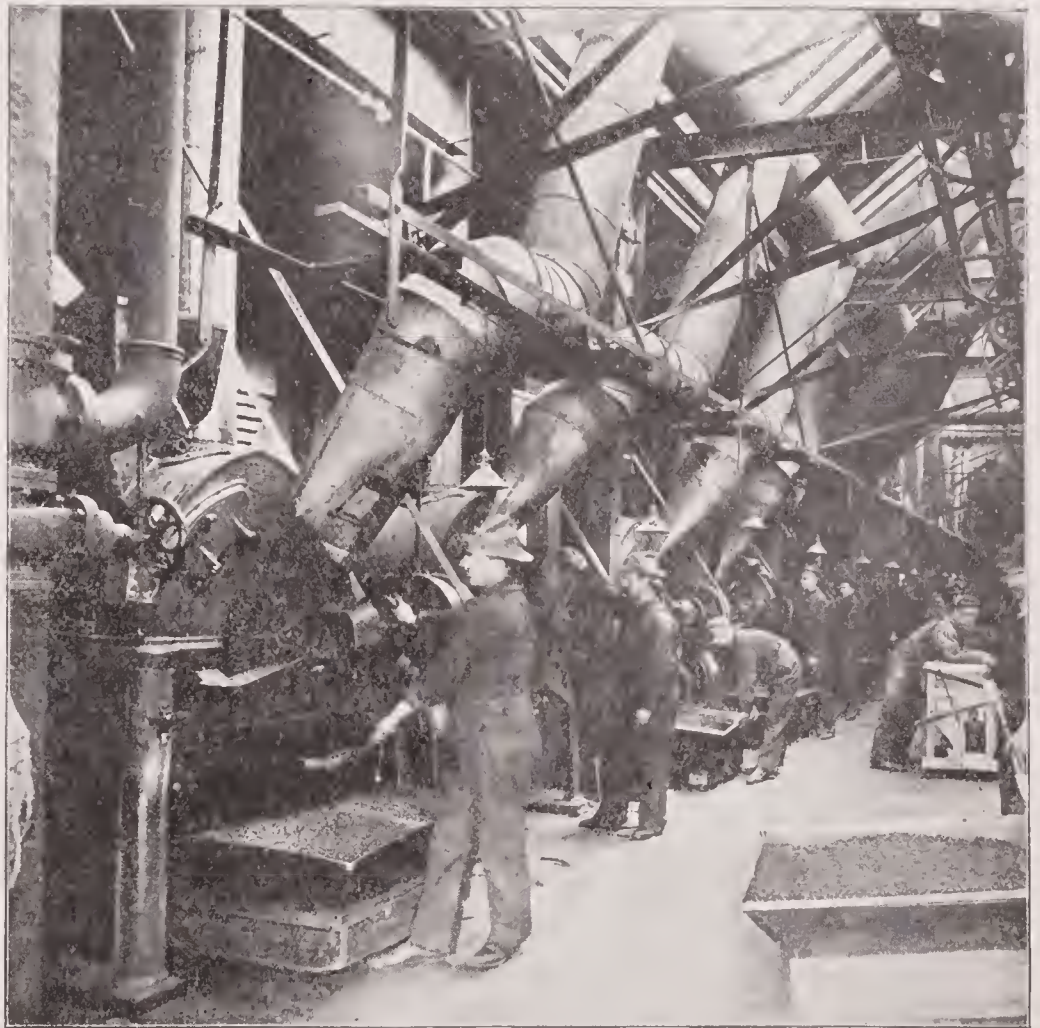
The average life of an olive tree is more than 250 years, but trees much older have been known to flourish and produce bountifully. Single trees in Sicily have been known to produce 240 gallons of oil a year, and to attain great size, the trunks measuring twenty-six feet in circumference and having an expanse at the top of fully 150 feet. Italy is the most important of the oil producing countries, yielding 70,000,000 gallons annually. Spain comes next with 23,000,000 gallons, and France follows with 9,000,000 gallons. The importation of bogus olive oil into the United States measures millions of gallons annually. Peanut oil, cotton seed oil, and other adulterations are imposed upon us.

COFFEE, TEA AND CHOCOLATE

The tropics and the orient have given to mankind three beverages now of world wide use. Coffee, tea and chocolate are known in every land, and varying in popularity each has its loyal adherents. Here in the United States coffee very much exceeds the others in popularity, with tea second and chocolate far in the rear. England is a nation of tea drinkers, with little favor given to coffee. In fact critics declare that it is hard to get a cup of good coffee in Great Britain. The English retort with, perhaps, equal truth, that it is difficult to obtain a cup of good tea in the United States. Holland is the country where the best chocolate is found, thanks to the Dutch colonies of the East Indies, where there is a large production of the bean from which it is prepared. France offers coffee as its favorite beverage, with chocolate and tea following in succession. It is in France that adulteration of coffee has been carried to the highest extent, and sometimes even in the best restaurants it is hard to trace the real coffee taste in the beverage offered. The Russians are the greatest of all tea drinkers, obtaining their supply chiefly by caravans into Siberia from the Chinese prov-

inces where the best crop is produced. The Russian samovar or tea urn is perpetually alight in every household of the empire, and tea is served not only at every meal but to every caller between meals and at all sorts of surprising occasions. Even a business call at bank or office is almost certain to bring the offer of a glass of scalding tea, to be taken while the errand is explained.

The range of coffee culture extends over almost the whole of the tropical belt of the globe. The plant seems to bear greater climatic extremes than most members of the vegetable kingdom, and thrives in localities differing as much as thirty degrees in aver-



LARGEST COFFEE-ROASTING PLANT IN THE WORLD.

age temperature. It is interesting to note that in many countries where the *Coffea Arabica*, the coffee of commerce, has been introduced, indigenous varieties of the coffee plant have been discovered. In Brazil, for instance, at least sixteen species are found growing in a wild state. The limit of average productiveness is about thirty years. After that time the trees may continue to live and grow, but they yield little or no fruit. In Java coffee trees

at six years may be said to be in full bearing. Taking one year with another, a tree in full bearing produces from two to three pounds per annum. The average diameter of the trunk in full-bearing trees is about the size of a man's wrist. They bear a profusion of dark green glossy leaves, and the fruit or berry forms on the woody stems usually at the base of these leaves.

The berry, when ripe, is red in color, and much resembles a large cranberry or medium sized cherry. The two beans lie within, face to face, and surrounding them are five successive layers of skin and pulp, covering and protecting the beans. Picking begins in Java in January and lasts for three or four months. The chief part of the Ceylon crop is gathered from April to July. A small crop, chiefly young coffee, is picked from September to December. In Brazil they commence gathering crops

in April or May, and work continues until September. Women and children are largely employed in gathering the fruit, carrying it from the trees in baskets to the place where the preparation of the berry for market commences.

After the berries have been gathered, the first operation to which they are treated is called "pulping." This means to remove the outer covering of skin and pulp from the beans themselves. The berries may be treated while in the soft state, or they may be permitted to dry, after which the dried husk is removed by a machine. When this process is chosen, the berries are spread upon drying-grounds of stone, mortar or cement, where they stay until the heat of



COFFEE YARD NEAR JALAPA, MEXICO.

planted nearly a hundred years ago are said to be in existence, being now some forty feet high with trunks a foot in diameter, but they grow entirely wild and produce no berries. On an average trees are replaced on the plantations every twenty years, and this process of replanting goes on constantly.

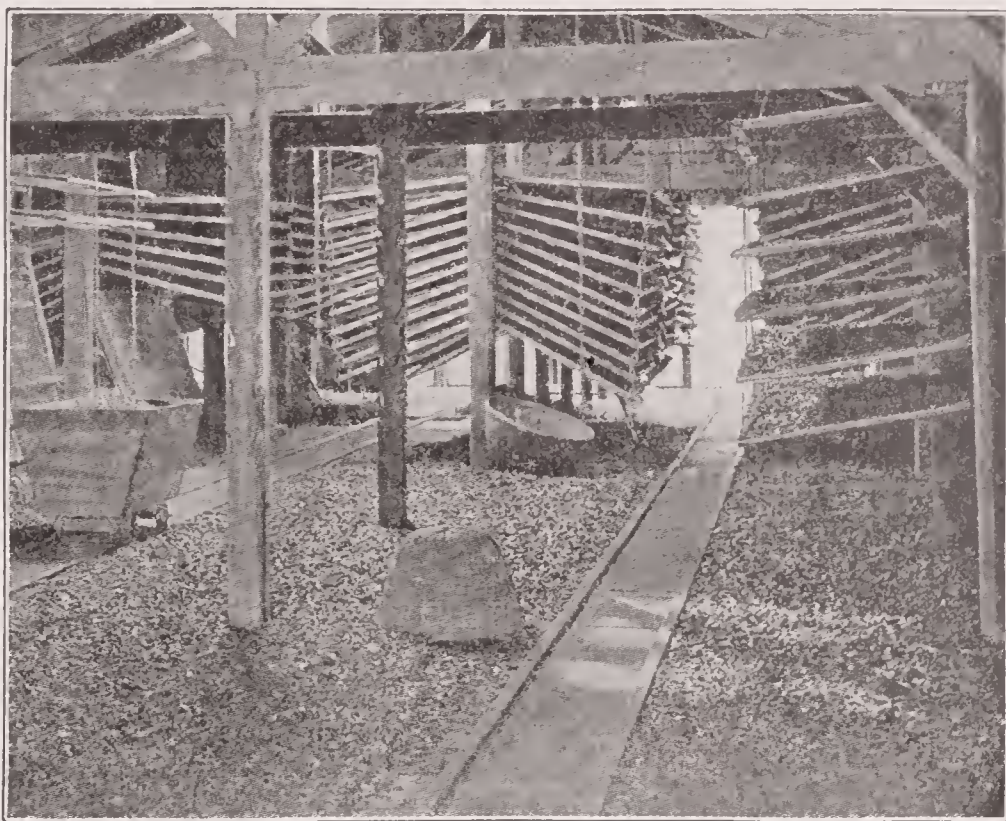
Coffee grows best on the uplands, usually on mountain sides, at an elevation of from 1,500 to 4,500 feet above the level of the sea. The trees are raised from seeds in nurseries, and transferred to their final positions when about a year or eighteen months old. The plants are usually set at intervals of eight or ten feet. They begin to bear at the age of three or four years and

the sun prepares them for the machine. It is a similar machine, differing only in details, which is used when the berries are to be treated in the soft state. Successive cleansings, washings and dryings finally bring the coffee into a condition for shipment to the markets, thousands of miles from the plantations where it is raised.

Coffee as a commercial staple is naturally inseparable from coffee as a popular beverage. Amsterdam was for many years the center of the coffee trade, owing to the fact that nearly all the coffee of commerce came from the Dutch East Indies. With the rise of coffee cultivation in Brazil, the West Indies, Central America, Mexico, Ceylon, India and Liberia, the Dutch lost their control of the trade, and New York became one of the most important coffee ports. The United States consumes more than one-third of all the coffee exported from the producing countries. Out of a total annual world production of 750,000 tons, the United States takes about 280,000 tons annually, of which nearly three-fourths is the product of Brazil.

In Abyssinia and Ethiopia, where the coffee plant is found both wild and in a cultivated state, coffee seems to have been used as a beverage from time immemorial. In those remote regions the Arabs are said to have first tasted the fragrant draught, and to have brought some of the

precious beans into their own country toward the beginning of the fifteenth century. The Mohammedan pilgrims who flocked annually to Mecca tasted the delicious beverage, and carried back coffee beans in their saddle-bags to all parts of the globe professing the faith of Islam. Coffee overran Egypt and reached Constantinople, where in 1554 the first coffee house in Europe was established. Nearly one hundred years later the first coffee house in London was established, in 1652, by the Greek servant of an English merchant who had brought some



DRYING TEA IN CEYLON.

coffee with him from Smyrna. Within a few years Marseilles, Paris and London had numerous cafés, and coffee drinking was becoming common in England and France. During the eighteenth century it spread all over Europe, although the enormous prices of the berry restricted the practice to the wealthier classes.

For more than fifty years after the in-

roduction of the beverage into Europe, Arabia still furnished the entire coffee supply of the world, a necessarily very limited quantity. Then the Dutch, early in the eighteenth century, appeared in the market with the product of Java, and a few years later the culture extended to the West Indies and spread with wonderful rapidity. Next Brazil entered the field, overtaking all rivals, until now more than one-half of the coffee consumed in the world issues from her fields. Java holds second rank in the list of coffee producers, Ceylon follows third, and southern India, Central America, Sumatra, Porto Rico, Mexico, Liberia and Arabia contribute to the world's supply.

The western hemisphere does not contribute commercially to the tea product of the world, although in our own southern states certain experiments have been made which suggest that good tea could be culti-

vated, even though it might not be highly profitable. Japan, China, the island of Formosa, India, and Ceylon are the principal tea producing countries. The tea plant is a species of camellia, bearing a thick and glossy leaf which when green has no tea flavor, or rather has a flavor very unlike the cured leaf known to us as tea. There is considerable variety in the mode of cultivating, but the prevailing system is to plant in rows about six feet apart. Three or four plants are planted together in hills which are about three feet apart, and usually as they grow larger they fill nearly the whole original space left between the hills, thus making an almost continuous row. The plants are raised from the seed, and take from three to four years to mature sufficiently to yield the first crop. After that they are picked continuously for many years.

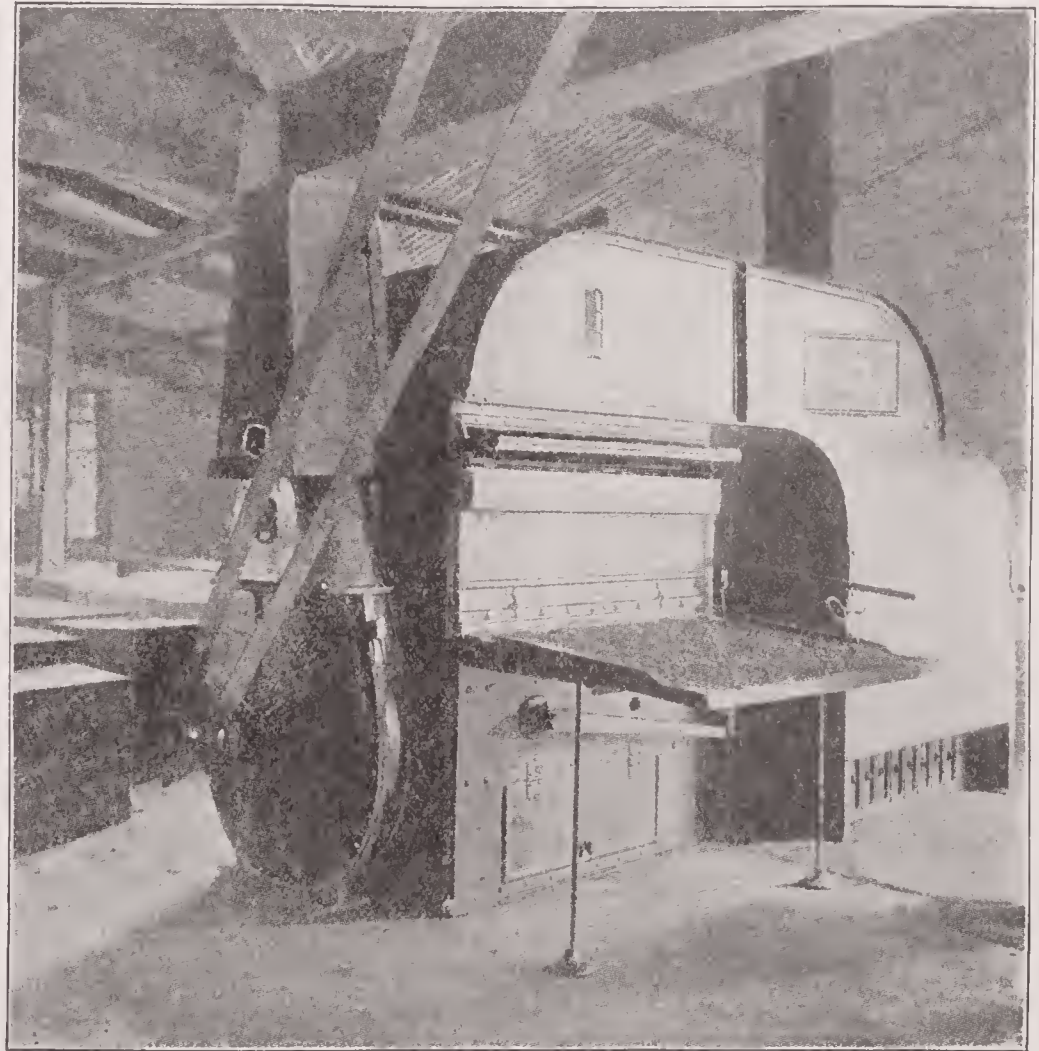


GATHERING TEA IN CEYLON.

During the winter and early spring, in the districts yielding the best variety of tea, the plants are covered with mats which serve the double purpose of protecting them first from cold which might injure the plants, and later from the sun which tends to make the leaf tough and injures the delicacy of the flavor. The first picking, which is considered the best, takes place in Japan the last of April or the beginning of May, the second about a month later, while the third, which is often omitted, particularly when prices are low, takes place usually during the month of July. Left to themselves the plants would probably grow to a considerable height, but they are pruned and trimmed down so that they are seldom more than three or four feet high. This results in a large number of small branches, producing small and tender leaves, which are the only ones sought for, although in rapid picking different sized leaves would naturally be taken, together with a considerable quantity of stems and other trash. Immediately upon being picked, the leaves are taken to the buildings for the curing processes. The flat baskets in which the tea is brought from the fields are placed over the steaming apparatus for a few seconds, the steam permeating the mass and wilting the leaves. This gives them

the dark green color, and enables the leaf to be rolled and doubled up, so that there is less liability to crumble when fired. They are then thrown upon large paper pans beneath which a gentle coal fire is maintained. They are toasted here for several hours, during which they are constantly rolled and stirred with the hands, so as to make the leaf as compact as possible. The tea is then placed in large baskets to await the sorting process.

The dried leaves are spread on a smooth tray before the sorters, who with a pair of chop-sticks dexterously pick out the stems and coarse leaves which are thrown aside as refuse. In the finer qualities they also separate the large from the small leaves, the latter being most highly valued. After the



DRYING TEA BY A HOT BLAST.



DELIVERING SUGAR BEETS AT THE FACTORY.

tea is thus sorted it is sifted to extract the dust and broken leaves, and packed to be sent to the market.

At the shipping ports, where tea is prepared for export, there is a second process of toasting or re-firing the tea, and an additional cleansing, after which it is packed in chests lined with lead which is soldered and closed so as to be air tight. Then after nailing the boxes, covering them with matting or rattan, and labeling them, the tea is ready for the ships which carry it to the American or European markets.

The methods followed in China are almost the same as those of Japan. In some sections artificially flavored teas are produced. Flowers are gathered from the jasmine, and scattered over the tea, which absorbs much of the fragrance and is highly favored by epicures. The brick tea, which goes overland to Russia by camel trains, is an inferior quality, composed of the dust and siftings, mixed with other tea of ordinary variety. This is consumed by the Russian peasants. An enormous quantity of the finest grade of tea is taken by the connoisseurs of the same country, who are con-

sidered to be the most exacting of all the world in their choice of tea. Chocolate is produced in several of the West India islands, in Peru, Bolivia and Ecuador, and the Dutch East Indies. It is a product of the cacao tree, which bears a large pod in which the coarse beans are formed out of which chocolate is made.

These beans are dried, roasted and ground. Cocoa is a modified preparation from the same substance. Porto Rico is the chief island of the Caribbean where chocolate is produced, and here is the principal source of the American supply. Students of health and diet of late years have recognized that chocolate is one of the most valuable food products, and not merely a stimulating beverage of doubtful value to the health like tea and coffee. Explorers and travelers now carry chocolate in condensed form as a valuable part of their commissaries. Soldiers find it in their rations, and invalids prize it as a food.



BEET SUGAR AND CANE SUGAR

When the Nebraska farmer drives into the factory yard with his ton of beets, he brings with him about 280 pounds of pure sugar secreted in the roots. Nature has been busy all summer with her apparatus of sunshine and rain, taking the elements of carbon, hydrogen and oxygen from the earth, air and dew, putting them together, and storing up the sweetness in the little sacs she has made for the purpose in the

beet-root; and the great piles of brick and mortar, the groaning engines and the roaring furnaces, the pumps and pans of the sugar mill have been devised to extract sugar from the root.

The older method was to grate the sugar beet to a pulp, press out the juice containing the sugar, clarify it a little, and boil away the water, leaving the crystals behind. But in this way from forty to eighty pounds of all the sugar in the ton of beets went to waste, for no press, however strong, could squeeze out all the juice, and the sugar would lie hidden away in the little particles of pulp. So the crude method has been superseded by a more perfect one, with the result that greater factories have grown, farmers have planted larger fields of sugar beets, and the industry has become a factor of importance in national politics.

When the beets are brought in by the farmers, they are dumped into long trenches, V-shaped at the bottom, from ten to twenty feet wide and from six to ten feet deep, either covered with sheds or simply open ditches. At the bottom of each of these is another ditch, reaching downward, with perpendicular sides twenty to thirty inches deep, and having a curved bottom eighteen inches wide. This is a sort of flume, through which water will flow. All the ditches slope toward the factory, and meet in one larger ditch near it. Before

the beets are thrown into the larger and upper trench, the smaller one is covered with short boards, laid across to prevent the beets falling into it. In these trenches or "silos" the beets are kept until needed. In warm weather they are covered with canvas or straw, and in cold weather with soil. When they are wanted in the factory, a stream of water is let into the upper end of the bottom ditch. The loose boards covering it are raised, and the beets are allowed to fall into the swiftly-running stream below, and are floated along to the houses. The water serves the double purpose of carrying and washing the beets.

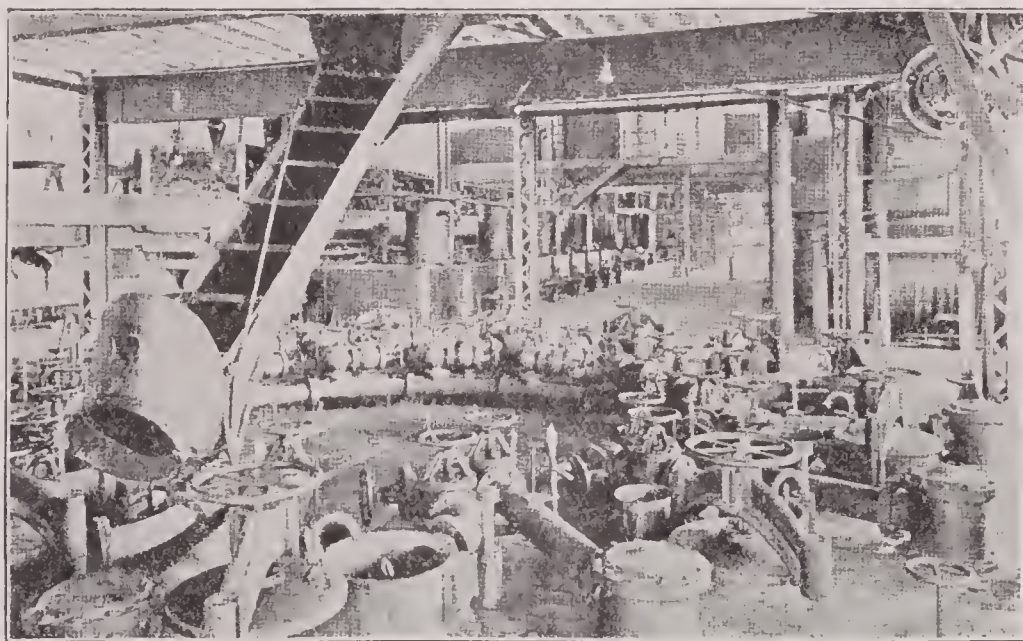
At the end of the ditch the beets are caught by buckets arranged upon the rim of a large revolving wheel, which lift them out of the dirty water and deposit them in the washing machine. This is a large, wooden, auger-shaped affair, lying horizontally in a round iron tank through which clear water is flowing. The revolving auger pushes the



SCREW ELEVATOR AT A BEET SUGAR FACTORY.

beets forward, rolling and tumbling in the water, and finally deposits them clean, in the elevating apparatus which carries them to the very top of the building. Here they are deposited into an automatic weighing machine which weighs half a ton of them at a time, and drops the beets into a slicer, a large wheel covered with knives, which revolves among the beets and cuts them into long, thin, diamond-shaped slices.

Immediately below the slicer, and upon the second floor of the factory, is a group of wrought-iron tanks that look like upright steam boilers, each large enough to hold



DIFFUSION BATTERIES.

about 3,000 pounds of the slices. These communicate with each other by means of large pipes. The first is filled with slices and water is then let in from a tank above. This is allowed to stand while the second tank is filling. Then the valves are opened into the next tank, containing fresh slices, and fresh water running into the first tank under pressure, forces the water which has already absorbed some sugar, on into the next tank, where it becomes richer. And so on from tank to tank it progresses, al-

ways tending to coax the sugar outside of the beet into the water. By a repetition of this process from tank to tank, the water gradually absorbs the sweetness from the beets and exhausts them of all the sugar to within one-tenth of one per cent. The exhausted slices are dropped from the tanks, and run through great rotary auger presses, and the partly-dried pulp is then shipped away for cattle feeding.

The apparatus just described is called the diffusion battery, and when once started, fresh slices are supplied and juice is drawn off almost continuously. The juice is of a

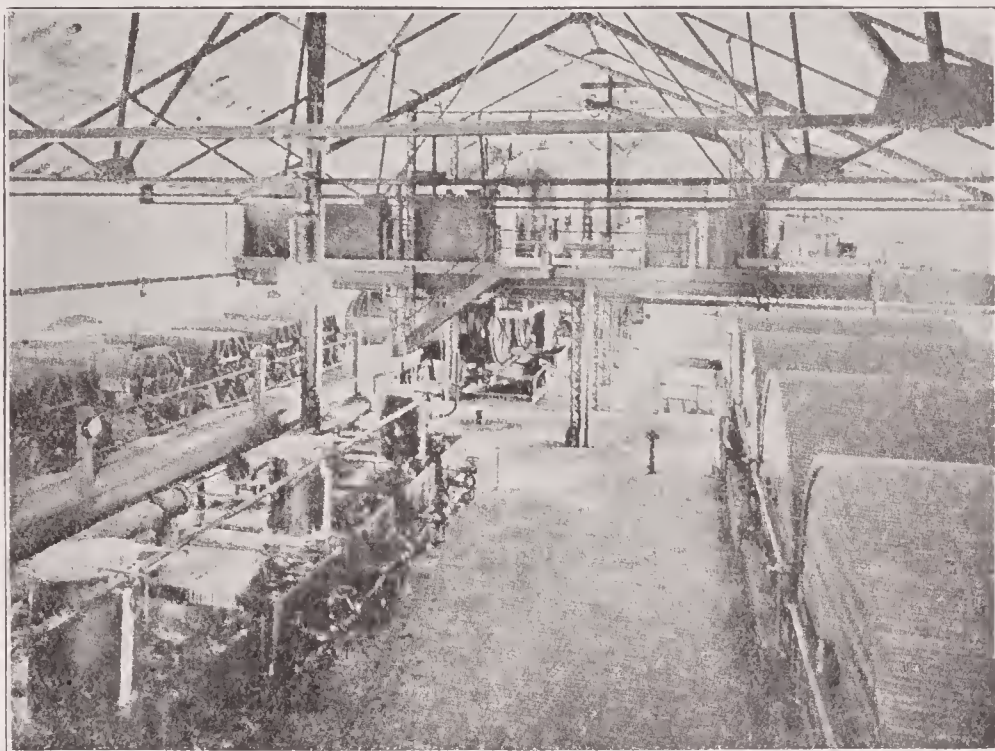
chocolate brown color, containing much organic matter not sugar. It is run from measuring tanks into tall, cylindrical vessels holding about 2,000 gallons. Here a thick lime solution is added, which takes out the coloring matter and other organic matter. Next comes a succession of boiling, filtering and clarifying processes, after which the fluid has become a

moderately thick syrup ready to be boiled down to sugar. The boiling process is a delicate one, which must be handled with care in order to get the best results. The syrup is pumped up into vacuum pans, large cylindrical bodies, some ten feet in diameter, with oval top and bottom. Great copper steam pipes are coiled inside, and a large air pump with an eighteen inch cylinder keeps up the high vacuum and removes the evaporated water so that boiling down goes on rapidly, and at a very low temperature.

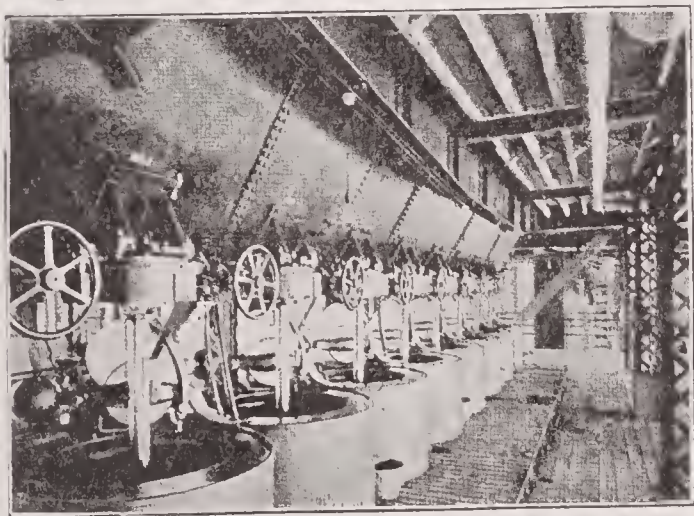
The sugar-boiler watches the mass through glass windows set in the sides of the pan, and when the small grains begin to appear, "feeds" them by adding fresh syrup until they are of the required size. When the grade is right and the water is evaporated sufficiently, the steam is shut off, the pump stopped, a valve is opened at the bottom of the pan, and the whole mass is allowed to run into the tanks below.

The syrup now looks about like dark molasses thickened with granulated sugar, and is so stiff that it will just run. This mass is drawn off into large whirling drums called centrifugal machines. These have their sides perforated with small holes, and are lined with gauze. The sugar rises up along the sides of the drums as they whirl, as water will in a revolving pail, and the molasses is thrown out of the holes in the sides, while the sugar too large to get through, remains sticking to the

gauze. The sugar is washed by directing a spray of cold water and air against it as it whirls, and a little bluing is added to give brilliancy. The machine is then stopped, and the sugar, which is now white and moist, is dropped from the bottom of the machine,



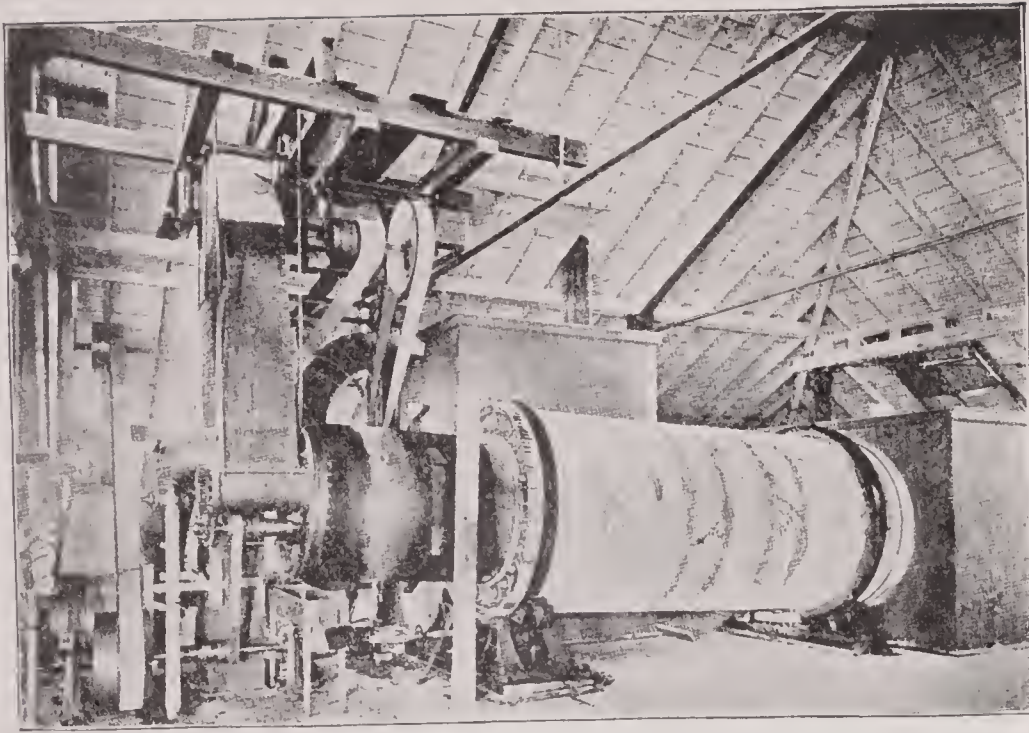
CARBONATORS IN A BEET SUGAR MILL.



THE CENTRIFUGALS.

and conveyed to a large horizontal revolving cylinder heated by steam and called the "granulator." It is here dried, and the fine dust of sugar contained in the granulator is drawn out by a suction blower. The sugar passes through screens at the end of the granulator, which removes the large lumps, and thence to the bags for market.

The molasses thrown off at the centrifugals is mixed with fresh syrup and boiled again, or is boiled alone and passed through the centrifugals, and the brown sugar resulting is refined by mixing with fresh syrup. A careful chemical control is kept upon the whole house. The laboratory has been called by one of the principal manufacturers, the heart of the factory. Here



SUGAR DRIER.

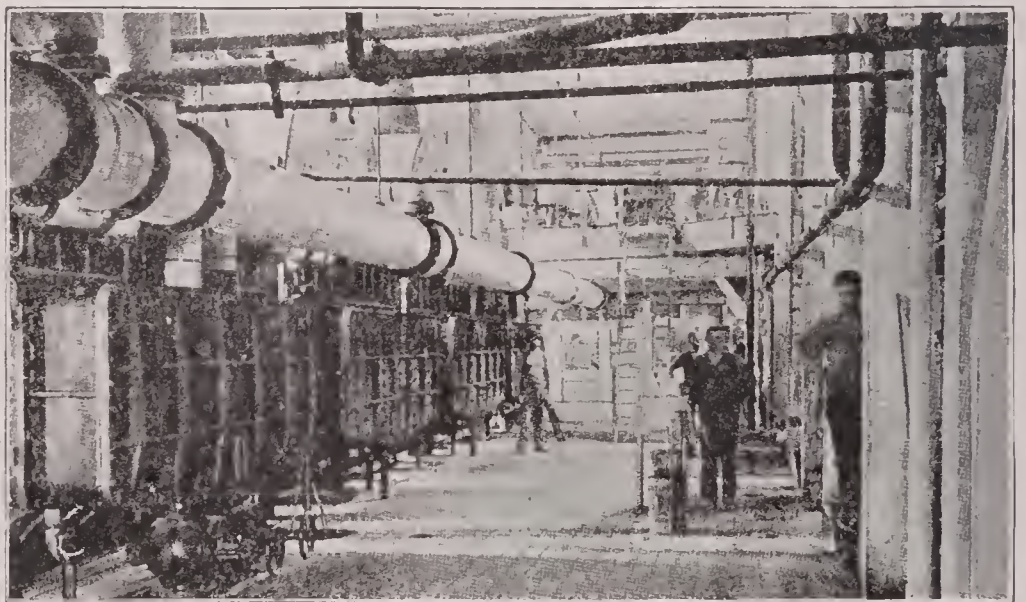
everything is tested — beets, juice, syrups and boiled sugars. Every pound of sugar entering the house is known from analysis and every loss is located and accounted for. In the laboratory are tested also the coal, the limestone, and the coke, the amount of ash in the raw sugar, and the value of soils and fertilizers. The factories run day and night, seven days in a week, stopping only to clean up or in case of an accident. And the sugar rolls out from each factory at the rate of thirty, fifty or one hundred tons a day.

If a Michigan chemist realizes his expectations, saw mills in the pine forests of the north may become active competitors of the Louisiana sugar plantations. He declares that he can make granulated sugar out of sawdust, and that he can do it cheap-

er than Cuba, China, Germany or any other country can possibly produce it.

The Louisiana sugar plantations produce less than one-fifth of all the sugar consumed in the United States, which is the chief reason for the rapid stimulus of beet-sugar production. In our Louisiana cane fields the harvest begins early in October. The negro field hands first strip the cane of its

leaves with the dull side of the knife, and then the tops are cut off as far down as the experienced cane cutter pleases and the maturity of the cane will permit. For while the sugar planter wants every inch of cane which will yield up sugar, he doesn't want to grind and handle an inch more than is necessary. The field hands begin work at daybreak, and cut enough cane during the day to keep the mill supplied for the suc-



DEFECATING PANS.

ceeding day and night. The cane is first weighed while on the wagon, and then dumped in the cane-shed, which is an open, heavily built wing of the sugar house. From the shed to the mill extends a traveling platform or conveyor. Colored women pick up the cane and spread it on the moving slats which carry it to the mill to be crushed. The roller mill is a ponderous piece of machinery, massive in all its parts, for sugar cane has a tough, hard skin, and cannot be crushed by tender methods. Sometimes nine rollers in succession are used to complete the crushing process. In the intermediate stage the crushed cane is called bagasse. When it is squeezed almost dry it is carried to the boiler room, for fuel, or it may be used for fertilizer.

When the cane is crushed, the juice runs down, a greenish, sticky liquid, through a strainer, to a vat from which it is dumped to the clarifiers. Lime and heat are used in this process, just as in making beet

sugar. The juice is boiled in a succession of open kettles, first to a syrup and then to sugar, being frequently skimmed of the impurities which rise to the top in the form of a scum, and are usually made into rum. When the tests show that the proper density has been reached, the heavy syrup is dipped into cooling-vats of wood, where the sugar is crystallized. Of late years vacuum pans and centrifugal machines have been introduced in the largest cane-sugar factories, like those used in beet-sugar making.

Enormous quantities of sugar are made in Cuba, Porto Rico, and the other West India Islands; in the northern countries of South America; and in the Dutch East Indies. Hawaii, too, has a large sugar industry. Germany and France are leaders in the beet-sugar industry; Russia and Austria are active in the same direction, and our own American farmers and sugar-makers are united in the development of the industry in this country.



CUTTING, STRIPPING AND HAULING SUGAR CANE.

OPIUM AND ITS PRODUCTION

Opium has done much to soothe pain in its various medicinal uses, and has put into a dreamy stupor many a devotee of its insidious fumes. Its effect in international affairs, however, has been far from soothing. English, French and Chinese blood has been shed in battle, and the diplomats of those three countries have used all their skill in settling the questions which have been raised over it. In the politics of Eastern Asia the opium question has been



FIELD OF WHITE OPIUM POPPIES IN BLOOM.

of admitted importance because of its commercial value to the tax collecting powers. In French Indo-China it has long been contended that this drug is the chief cause of difficulties with the native races, and that the famous pirates on whom the French made war were simply honest merchants whose affairs were interfered with by the opium monopoly. It has always been charged against Great Britain that the war with China some forty years ago was incited only by the British desire to establish the opium trade which has become the

curse of the Chinese empire, and peace was permitted only when the Chinese yielded to the admission of the opium against which they had struggled so long.

Opium, as every one knows, comes from the poppy, of which many varieties flourish in our own flower gardens. The nature of the soil and the climate have great influence on the chemical qualities of the various plants, which are found in Persia, China, and more especially in India, where for a long time the English government has monopolized its culture as in France the government monopolizes the culture of tobacco. In all the immense and fertile valley of the Ganges, nothing is asked of the earth except the poppy. The districts of Patna and Benares are distinguished by the richness and abundance of their harvests. At the season's blossoming the air is saturated with a soft, enervating perfume, and nothing equals the monotony of an Indian landscape when the dried petals of the flower detach themselves and cover the soil. The product of this culture in the province of

Bengal alone is estimated at 15,400,000 pounds which represents a value of \$30,000,000.

Opium is extracted from the matter which exudes from the green, unripened capsule of the poppy. This matter is gathered in little globular particles of amber color, by means of a special instrument. It is put into earthen pots, carefully covered, and transported to the laboratories of the English government, where it is massed into balls about the size of a Dutch cheese. These masses are covered by the

petals of the plant, which have been reduced to powder in order to prevent their adhering to each other. After being dried methodically, the masses are packed and sent to Calcutta, the market which supplies all Asia.

From this raw opium is made the finished product which is used by smokers. The process is a very delicate one, and only the Chinese know how to get the very best results. The raw opium is brought from Calcutta to the place of manufacture, to the opium-boiling establishments. The ordinary place of this kind contains four large boilers and 160 small furnaces, with basins constructed of masonry, in the form of a long bench. First the balls of opium are cut in half, and from the inside the raw opium is taken with the fingers. That which remains attached to the envelope of petals is afterwards secured by placing it in the boiling water. These preparations completed, the opium is placed in the basins with water, where it is boiled for two hours and constantly stirred until it reaches the necessary consistency, which nothing but long practice can determine. The worker seats himself on the ground, his basin between his knees, and with the aid of a small instrument works and kneads the mass before him, over and over.

The mass is now spread over the inner surface of the basin, which is tilted so that the direct heat of the fire is radiated against it. Under this influence, the external surface of the opium loses part of its moisture, and then becomes softer. The basin is then taken from the fire, and the cold air operating on the surface of the mass hardens it suddenly, while the part below the surface retains its paste-like consistency. The worker seizes the hardened crust and de-

taches it from the rest of the mass. The basin is then exposed to the fire again and a second crust is detached and sometimes even the third one. These crusts are then broken and placed in the basins full of water. In about twenty-four hours all the solid parts of the opium are separated and the liquor is filtered and evaporated at the fire to a sufficient consistency. After being exposed to the air the extract is put into copper vessels where it is left long enough to undergo fermentation which removes from it the acrid principles and permits it to acquire all of its necessary properties.



A CAMPHOR TREE.

The opium now presents itself in the form of a cake, brown in color like molasses, and exhaling an aroma difficult to describe. The precious drug is put into small metallic boxes of various sizes and at last is ready for the market at a price ranging from twenty dollars a pound upward, according to quality, taxes and import duties in the countries where it is consumed.

Of course its high price and the restric-

tions placed about the production and sale of the drug, account for the widespread theft and smuggling of it, with which all countries have to contend. It has its distinct value in science, but except for the medical and surgical uses to which it is put, it would be better if this insidious decoction of the innocent poppy were blotted out of existence.



TOBACCO RAISING AND CIGAR MAKING

Of all the contributions which the western hemisphere has made to the world since the voyages of Columbus, probably no product has gained more universal use than tobacco. It is declared that there is no other

luxury in the world for which so large a sum of money is annually paid and, indeed, it has been taken out of the list of luxuries and has become a necessity to many millions of people. It has therefore become in an industrial sense one of the most important products of agriculture and commerce.

An exploring party searching for strange things in Cuba, reported to Columbus on his first voyage, that they saw people who carried fire brands and perfumed themselves with herbs which they carried with them. On the second voyage the habit of snuff taking was observed. Tobacco chewing was noticed by the Spaniards on the South American coasts in 1502, and, as exploration advanced, it was found that tobacco smoking was common all over the new



CUTTING TOBACCO ON AN AMERICAN PLANTATION.

world, dating from time immemorial, and that it constituted an important factor in all tribal negotiations and religious ceremonies.

Francisco Fernandes, a Spanish physician, was sent by Philip II. in 1558 to ascertain the natural products of Mexico, and it was he who first took the plant to Europe. Jean Nicot, the French ambassador to Portugal, sent some tobacco to Catherine de Medici, and his name has been commemorated in the scientific name of the tobacco plant, *Nicotiana*. At first it was supposed to possess almost miraculous healing power. It went to Europe through Spain, but its use was introduced by the English. Ralph Lane is said to have been the first English smoker, and through the example and influence of Sir Walter Raleigh, the habit spread among the gentlemen of Queen Elizabeth's court.

There are many species of *nicotiana*, but those of which the leaves are used for smoking are few in number. These with but two exceptions, one a native of New Caledonia and the other of Australia, all are of American origin. The tobacco plant flourishes over wide areas, but is best suited for regions having a mean temperature of not less than forty degrees, where early autumn frosts do not occur, and where there is neither excessive moisture or drought. Tropical climates develop the finest qualities, where there is no excessive moisture. The tobacco plant absorbs its food from the soil very rapidly and leaves it in an exhausted condition. This makes liberal fertilization necessary and the character of the fertilizer exercises a wonderful influence over the quality of the tobacco.

There is a saying in our own southern states, that the cultivation and saving of a

successful tobacco crop requires fourteen months every year. This is justified by the fact that actual work on the crop begins by January first, and continues with little intermission till March or even May of the following year. In addition to the actual cultivation, it involves a warfare on pests from the start.

About the first week in January the planter goes into the thick woods where there is a good southern exposure and picks out a place for the plant bed. Then the negroes set to work clearing the required space. After the square is thoroughly cleared it is covered with fertilizer and then the seed, which is like a quantity of ground black pepper, is sown over the ground and whipped in with a brush. Forty days' time is required for it to sprout. A little while after the seed is sown, the bed is covered with a flimsy cotton cloth to guard against the frequent changes of weather at that season and keep off the pests which would destroy young plants. Early in May the plants are large enough for transplanting into the field, which must be put in the very nicest order for their reception. The weather has much to do with success here, for it is only in a wet spell that sprouts will survive transplanting. The cultivation proper is not the most exacting part of the undertaking. The plowing or hoeing must be well, and even nicely done, but it extends over a period of only about six weeks.

When the plant is six weeks old it is topped to ten or twelve leaves, and almost immediately false leaves or "suckers" start at every joint, beginning at the bottom. As these detract from the proper growth of the leaf, it is necessary to go over the crop each week until cutting time, and pull off every new sucker that has been put out. As

many as three successive sets of suckers will start at the base of every leaf.

The most picturesque feature of the whole season is the worms. Where does the worm come from? Who ever saw one in a country where tobacco was not raised? But let a man go to Alaska and get a good crop of tobacco under way and some morning when he goes out to look the prospect over he will be greeted by the tobacco worm. A



CUTTING TOBACCO IN CUBA.

great many of the worm's brethren, also, and their progenitors, the tobacco fly, will be there. He is a big worm, and if he were to make his appearance suddenly on the floor of a house in a region where tobacco is not known, he would have possession of the place very quickly. But his appearance does him injustice. He is not as dangerous as he looks, and his only bad habit is tobacco. If left alone he would ruin a crop in two weeks after his arrival. But the little negroes do not leave him alone. They take him familiarly between a thumb and forefinger, and end his career at once. Planters offer a bounty of so much a dozen for worms taken from their fields, and a

much greater reward is paid for the capture of the tobacco fly from whose eggs the worms hatch. There is no very great number of tobacco flies. A very few, say a dozen or so, would plentifully supply a whole plantation with worms, and so the early destruction of the fly goes a long way toward abating the pest. To accomplish this an occasional "jimson weed" is allowed to grow in the field, and when these are in blossom

a small amount of cobalt mixed with honey is placed in the flower. As the fly feeds on the blossom, a very small amount of the cobalt is fatal to him.

In about ninety days after the planting, the tobacco is ready to cut. When ripe the green is dappled over with slightly yellow spots. For cutting, a strong knife is used. A large number of sticks about

three feet long are then distributed over the field. One man holds the stick, while another cuts the plant, splits it near the base, and hangs it on the stick. Five to seven plants are placed on the stick, which then is laid on the ground to be taken up into the wagon following, and hauled to the barn.

The tobacco barn is a tightly constructed log building, about twenty feet square and almost as high. There are two furnaces inside, which are arranged to be fired from the outside of the building. There are sets of horizontal poles across the interior, from which the sticks of green tobacco are suspended. The barn holds about 800 sticks,

probably the yield of a little less than an acre of ground. When it is full, the door is closed, and the fires are started, to be kept going night and day for four days. Beginning with a very low heat, it is increased to about 100 degrees by the end of the first twenty-four hours. Too sudden heat blackens the stems, and otherwise affects the color injuriously.

Beginning with the second day, the temperature is increased about a degree an hour, until 125 degrees is reached. It is held at this temperature for from eight to twelve hours, after which the thermometer is started up again, until 180 is touched, and the heat is held at that until the stem of the tobacco is thoroughly "killed." Then the fires are drawn, and a quantity of water is thrown in upon the ground, the vapor from which puts the now brittle leaf in condition to be handled without injury. Then the tobacco is taken out and stored away and the barn is ready to be filled again.

Firing or curing is a delicate and difficult task to do properly. It is necessary to replenish the fires and observe the thermometer every hour. Burning a barn and its contents on the third or fourth day is not infrequent. The heat becomes so intense that a spark sets it off with almost an explosion. Tobacco cured thus in closed barns is much lighter in color than that dried in the sunlight or in the open air. The lighter and evenner the color, the higher the price it brings in the market.

After the curing is all done, comes a long-drawn-out task in which the men, women and children all participate—that of stripping the leaves from the stem and tying them into bunches or "hands." This task is not continuous, as often for two or three

weeks at a time the leaf is too dry to handle. When the air is moisture laden it becomes as soft and pliable as a kid glove. As the stripping is done, the leaves are sorted by color into as many as seven different grades. When there are ten or a dozen leaves of one color and grade, they are secured by placing the stems together, wrapping an extra leaf tightly around them, and drawing the end between the other leaves. This is now called a "hand," and is the form in which tobacco is marketed.

It is now ready for "bulking" for fermentation. For this purpose it is piled or stacked upon the floor of the barn or dry house. Fermentation is quickly set up, and the temperature steadily rises to about 130 degrees. Care must be taken to prevent over-heating, and to secure uniform fermentation. This is accomplished by taking down and restacking, putting the top to the bottom, and the outside into the middle.

It requires from three to five weeks to complete this process, depending, of course, upon the quantity in the mass, and the atmospheric conditions. The leaves should now have a fine brown color, and can be left in the mass until the following summer heat sets up what is termed the May sweat, when it is necessary to give it careful attention again.

The net yield in money to the planter varies greatly. To insure success the closest attention is necessary at every stage of the work. A storm just before cutting-time sometimes damages the crop one-half. A bad job of curing, on the other hand, would take away nearly the other half. If the soil is very rich it is likely to add to the weight, but it more than counterbalances that gain by detracting from the quality. One Vir-

ginia or North Carolina "cropper" or renter, if he has a couple of boys and can depend on the rest of the household on demand, will undertake the cultivation of eight to ten acres. With fair luck he will make 500 pounds to the acre,



BALED TOBACCO IN THE WAREHOUSE.

which should bring him approximately \$75 per acre.

Tobacco is grown in a dozen states in this country, and is divided in a general way into "seed leaf," which is grown in the Connecticut River Valley and Ohio; "bright leaf," the characteristic product of Virginia and North and South Carolina; "white burley," peculiar to Kentucky, and "shipping leaf," which has a wide range of country to grow in. The processes everywhere are much as they have just been described.

The "hands" are pressed into hogsheads for shipment to the warehouse, by means of a simple screw press, set in a frame of heavy timbers. In each of the big tobacco

markets, Louisville, Cincinnati, St. Louis, Richmond, Clarksville and Henderson, are great buildings with broad, open floors, the tobacco warehouses which are characteristic of the place. The hogsheads of tobacco are rolled in upon these floors, and the cask

itself is removed, leaving the mass of tobacco still retaining the form of the hogshead into which it has been pressed. The inspector sticks an iron hook into the tobacco and removes a sample. Three samples are taken from each hogshead and are tied together, sealed, marked with the name of the owner, the weight, and the warehouse number of the hogshead. Then the bundle is laid on top of the cask. The auctioneer who sells the to-

bacco passes the bundle of samples around the crowd of buyers, and when each has examined it sells the hogshead to the highest bidder. The purchased tobacco then is sent to the warehouse of the buyer, to be made into cigars, cigarettes, plug or fine-cut chewing tobacco, or smoking tobacco.

A great improvement has been made in the processes of tobacco growing in Connecticut and Florida, by the introduction of cloth shelters over the entire growing crop. Posts are set all over the field to be planted, and over these stringers and galvanized wires are stretched. Then a great canopy of cloth is spread over the field, the whole preparation costing about \$250 an acre. In these tented tobacco fields the

plants are immune from insect pests, from the changes of climate, from the effects of the direct sun, and from many other difficulties which the planter ordinarily has to face. The coverings are strong enough to stand any ordinary wind, and the plants are not lashed and torn by the storms. Within the tents a continuously tropical climate exists. The leaves grow more luxuriantly, and the plants increase to great size. The tobacco with which these experiments have been made is the Sumatra product, for which this country has been sending annually the sum of \$6,000,000 to the Dutch East Indies. The Sumatra wrapper is considered essential for cigarmaking, and the great profit produced by this successful experiment promises to keep this money at home instead of spending it for the imported product.

Hundreds of millions of cigars and cigarettes are burned each year, and the making of them supports an immense army of workmen, who supply the tools, boxes and labels and who roll the fragrant cylinders. The cigarmaking business is one of the few which holds at bay the labor-saving machine. Numerous efforts have been made by sanguine inventors, who saw fortunes in a practical machine, but the hands and fingers of the cigarmakers, aided by the simplest of tools, continue to roll and shape the tobacco leaf into the finished product ready for the smoker. Few trades require less in the way of tools than the cigarmaking industry. Give the skilled workman a hard maple board on which to roll his cigars, a knife, some paste and tobacco leaf and he is well-equipped. But, like most trades where the fingers are the principal tools, the cigarmaking business must be learned from the very beginning. From

three to five years are required to make a skilled workman out of a boy, and sometimes men cannot learn the business at all.

Cigar manufacturing may be divided into two general divisions, hand and mold-making. There is considerable difference in a technical way between Spanish and American methods, but the difference comes in minor details, which would not be noticed by the casual visitor to a cigar factory. The fact is, nearly all ordinary cigars are made alike, whether the cigar box has a New York brand, a Key West label, or a Havana mark. The better class of cigars are the hand made, and most of the cheap grades are mold made. In either case the beginning is the same.

The tobacco leaf is moistened, stripped, separated into its grades, and "booked." This work is done by boys who are learning their trade, or by girls. The strippers tear the leaf from the thick middle stem, and if the leaf is to be used for wrappers or binders, they place the spread-out leaves, one over the other, into a book. Before the leaves are stripped they are moistened by being dipped in water, and laid away over night between damp cloths in a box. In spreading the leaves out for examination and stripping, some skill is required, for the stripper must know by the feel of the leaf just how much stretching and smoothing it will stand before tearing. This is a trick of the trade which can be learned only by experience. The stripper does more than this, however, for she separates the leaf into the various grades, and boys are set to work stripping, because they thus not only learn how to handle the leaf, but learn the fine distinctions between "wrappers," "binders" and "fillers."

The filler is the core or the body of the

cigar; the binder is the leaf which is wrapped around the filler, and the wrapper is the outside of the cigar. The best-looking, largest and smoothest leaves are used for wrappers. The stock which does not quite fill all the requirements for a wrapper is used for binders, and the filler is stock which does not come up to the binder standard. This difference is not so much a difference of quality as of appearance, for the same bunch of tobacco leaf which is taken from a bale will be divided into three classes.

The cigarmaker works seated before a table on which is his "board," blade and

maple, glued and dovetailed together to make a solid block about a foot square. The wood is cut across the grain, so that the surface of the board is made up of the cross sections of the smaller blocks of maple. The binder-stock is moist enough to bear the working and handling without crumbling. The binder-stock is more moist than the filler, and the broad leaves to be used for wrappers are so moist that the leaf feels silky to the touch and is elastic.

The workman makes a bundle of tobacco leaf for the filler, arranging the bits so that the tips of the leaves are toward the butt of the cigar, or that end which is lighted. He

lays the tobacco in the hollowed palm of his hand, so that the bits lie parallel, and packs them together so that the bunch is solid but not tight. This bunch he lays in the center of the trimmed leaf he has selected for the binder, and with a dexterous combination of twist and roll he wraps the binder around the filler and then puts the wrapper on. The tool he uses for trimming the leaves to shape is called



UNPACKING TOBACCO FROM THE BALES IN A CIGAR FACTORY.

tobacco leaf. A cloth pocket extends the length of the table, with its open top just above the workmen's knees. The scraps and bits of leaf cut off by the workman are thrown into this pocket, and the three grades of leaf are spread on the table in little heaps, each grade separate. The board on which the cigarmaker trims the leaf and rolls the cigar is made of blocks of hard

a blade. It has no handle, and resembles the blade of a meat-chopper used in a kitchen when the cook makes hash for breakfast. The edge of the blade is curved, and the cutting is done by rocking the blade over the leaf on the board. Knives with handles are used for the same purpose. The blade is also used to roll the cigar when the wrapper is put on, and the rolling not only

gives the cigar a more cylindrical shape, but puts a sort of polish on it.

In cutting the wrapper the cigarmaker endeavors to leave out the thick veins. The wrapper is cut or trimmed twice, once to give a narrow strip, and the second time for the "head." The head is not cut out until the wrapper is on the body of the cigar and the workman is ready to twist the point. Then he cuts the wrapper in such a way that it will twist up to the point, but before the point or head is made, he puts on some gum to hold the point in place. The cigar is then cut to the right length, rolled, and laid to one side finished. The process just described is generally called the "German hand-made" process. It is the one commonly used in the smaller shops in Chicago.

Mold-made cigars call into use wooden molds which press the "bunches" to shape, ready for the wrappers. The molds are made of two pieces of wood in which cigar-shaped recesses are cut. Less care is used in bunching the filler and wrapping on the binder, for the mold gives the shape. The partly made cigars are placed in the molds and squeezed for an hour or so in a press. Then they are turned half way round in the molds and pressed again, and when taken out are "rolled" and cut to length. Two hundred and fifty cigars are a good day's output for one workman on hand-made goods, but 500 cigars have been made in one day by one cigarmaker working with molds.

Spanish handmade cigars are made without binders, for the workman spreads out each leaf of the filler in the palm of his hand and twists them to shape and puts on the wrapper almost in one motion.

After the cigars have been laid neatly in

rows in the cigar box the lid is closed over them and the box is put in a little screw press, which jams the cigars down snug enough to permit the lid to touch the wood, for the cigars more than fill the box. Then a number of boxes are placed in a larger press, a board is laid over the top row, the screw is turned down upon the board, and all of the boxes are kept in the press over night. Then the lids are tacked down and otherwise fastened, and the cigars are ready for the "trade."



HOW TRUNKS ARE MADE

Travelers need more than trains and steamships to make their journeys pleasurable. They must have their baggage with them, and thanks to the assaults made upon it in transit by their eternal enemy, the baggage master, they must see to it that trunks and valises are strong enough to stand the shocks to which they are submitted. It has been suggested that the men who make trunks and the "baggage smashers" who apparently attempt their destruction, represent two great industries in a state of mutual antagonism like that which exists between the makers of armor plate, the builders of hundred-ton guns, and the inventors of high explosives.

The trunk-maker selects for the body or box of his trunk, sheets of thoroughly seasoned basswood. This may be used solid, or in veneers glued with the grain of alternate sheets at right angles. For the best trunks the veneers are used, and are glued together so strongly that it is almost impossible to separate them. The nails used in fastening the box together at the joints and angles are of steel wire, coated with gum to increase the holding power.

After the box is completed it next receives a covering of strong canvas or duck, pressed upon hot glue with a heavy roller. This adds strength to the wood, and keeps it from splitting, besides giving an elastic surface for additional durability. After the glue has dried, the canvas is painted whatever color desired.

The next process is to put on the hardware, the defensive armor which contributes additional strength at corners, edges and joints, where reinforcement is necessary. Strips of tough steel and angle-iron are used for this, and the nails of Swedish iron are all clinched. Next hickory strips are nailed on to the body the long way of the trunk, not merely to strengthen the box, but to act as skids upon which it may slide with its heavy load when dragged over a truck by the baggage man. The successive corner clamps, handles, hinges and the other fittings are heavily riveted, and the

lid is put on with the utmost care. This calls for the most expert workmen, for the lid must be opened and closed easily, and yet when closed and bolted must be as strong as the solid body.

The lid is not fastened to the trunk until after the trunk lining and lid lining have been put on. Various fabrics are used for linings, such as linen, grass-cloth, duck, cambric, flannel and velvet. After the lining is completed, the lid joined to the trunk, and the lock set in place, the outside of the trunk is varnished and it is ready to receive its trays. The trays are made of basswood, thin and light, but bound with fine steel clamps which are hidden under the lining. They are constructed with great care, for they, too, must withstand twists, strains and hard usage. When the trays are in place the trunk is ready to travel.

Probably the strongest trunk made is the raw-hide trunk. This is produced at con-



INTERIOR OF A TRUNK FACTORY.

siderable expense and by not many manufacturers, the name being a synonym for the highest grade. The first raw-hide trunks made in the west were built out of buffalo hide for a Chicago wholesale house twenty-five years ago, and those identical trunks are still on the road, packed with dry goods samples.

Trunks are made out of basswood, tin, sheet iron, sole leather, canvas, split leather, willow, rattan, paper and pine. The commercial traveler is the trunk-maker's best customer. These traveling representatives of wholesale houses use trunks to carry all sorts of things. A trunk was made recently to carry an iron safe for a sample. A musical instrument house in Chicago orders trunks large enough to hold a complete organ, and traveling men for a stove house carry full sized samples of their goods in

trunks. The large trunks for bicycle salesmen have become an important part of the product. Theatrical companies likewise are among the best customers of the trade.

Valises and traveling bags of various sorts, of which the dress suit case is the most recent and popular form, are likewise made in great number at the trunk factories. The finest leathers are used and in the more expensive grades such traveling bags are fitted with silver and cut glass toilet utensils and all the equipments of a lady's boudoir.

For making high grade trunks and valises, high grade labor must be employed. It is declared that expert workmen in such occupations are paid the highest wages earned by any mechanic or bench laborer in any manufacturing line in the United States.



MAKING VALISES AND TRAVELING BAGS IN A TRUNK FACTORY.



SCENE IN THE REMARKABLE SALT FIELD IN SOUTHERN CALIFORNIA.

Salt cones ready for the mill after the Indian laborers have washed it.

SALT AND ITS PRODUCTION

It would be difficult to name anything more universally required by mankind than the common, cheap and simple substance which we call salt. Indeed, not only mankind, but animals as well, find it essential to their health and will undergo any difficulties necessary to obtain it. Fortunately for the world there is nothing more generally found and nothing cheaper. The ocean, which occupies approximately three-fourths of the surface of the globe, holds inconceivable quantities of salt, carried into it by the rivers which it receives, and absorbed from the salt beds upon which it rests, and this supply in the greatest of storehouses is never diminished by evaporation. On land, underground and surface deposits of salt alike are found the world over, and great inland bodies of water are saturated with this simple substance, which they are ready to yield at the demand of the salt-gatherer. Salt is obtained in ways that differ as widely as do the localities where it is found. Perhaps the most picturesque and interesting of all the salt gathering industries is found in our own country, recently developed, but already taking an important place in the production of salt for the market.

Away down in Southern California in

the middle of the Colorado desert, about 100 miles from the ocean and eighty miles from the Mexican boundary line, is the little station of Salton, on the Southern Pacific Railway. It lies between the San Bernardino and the San Jacinto ranges of mountains. Between these ranges the valley sinks to a level some 400 feet below the level of the sea, making it the most depressed spot in the United States. In this remarkable depression, a short distance to the south of Salton, is a field of crystal-



GATHERING SALT IN MEXICO.

lized salt some 300 feet below the level of the sea and more than a thousand acres in extent. Here the company owning the tract employs a number of laborers in the gathering of salt for the market, by methods genuinely unique.

The salt itself exists as a crust over the surface of a marsh. It is constantly supplied by salt springs which flow from the



A DRY SALT SEA IN THE DESERT.

surrounding hills draining into the basin, where they rapidly evaporate, leaving the deposits of almost pure salt. The salt crust thus formed varies in thickness from ten to twenty inches.

The process by which the salt is collected is simple in the extreme. The crust is plowed by a salt-plow, resting on four broad-tired wheels and managed by two men. A railway track runs across the salt field at either end at right angles to the direction in which the plowing is to be done and a locomotive works back and forth on this line. From it steel cables are carried around pulleys and then hooked on to the plow, and the locomotive tugs away, drawing the peculiar implement the full length of the field. The heavy steel share makes a broad furrow but a shallow one, leaving parallel ridges on the crust on either side. Between the wheel tracks the brine is exposed that seeps from the underlying salt springs. Laborers with hoes work the salt in the water, to separate the earthen particles that have adhered to it, and when this is done they stack up the clean salt in conical

heaps ready to be hauled to the mill. The water in which this washing process goes on is itself so saturated with salt that it can absorb no more, so that there is no loss by the washing.

The surface of this remarkable field of salt is snow white, and its brilliancy in the clear light of the California sun is so dazzling that laborers have to wear dark glasses to protect their eyes. These laborers are either Japanese or Indians, for no white man can stand the intense heat. For weeks at a time the temperature averages 140 degrees, and the uninterrupted sunshine reflected from the dazzling white surface produces a glare that is almost intolerable. Even the Japanese laborers confine their work to the sewing of the sacks in which the salt is packed. The field work and the work in the mill are done entirely by Indians of the Coahuila tribe.

In order to supply additional water for washing the salt, the company sunk an artesian well to a depth of 900 feet. Even this is still strongly alkaline, but it is the only source of water for domestic pur-

poses. The air, laden with impalpable particles of salt, stimulates an intense and painful thirst which the workmen find it impossible to quench with the lukewarm water of the artesian well.

Out of this field of 1,000 acres of virgin salt, not more than ten acres are worked at this time, and yet from such a small portion about 700 tons of salt can be plowed and shipped daily. As fast as the crust is removed a new crust forms almost immediately after the plow has passed on.

lakes and towering cities appear in most deceptive form. The effect of moonlight on the white expanse is singularly weird and beautiful.

The salt deposits of the ocean itself are utilized as a source of commercial supply in many countries, and particularly in the islands of the sea where other supplies do not exist. Even on our American coasts, however, the business possibilities of this industry are not neglected, and in the neighboring islands of the West Indies



AT WORK IN THE SALTON SALT DEPOSITS.
Indian laborers plowing, and, in background, loading salt on flat cars.

The drying and milling works are at Salton. After the salt has drained in the conical mounds in the field, it is loaded on flat-cars and hauled to the works. Here it passes through a mill which grinds it to powder and then it is sifted and packed into sacks for the market, in which it is recognized as of the best quality.

Under certain atmospheric conditions this salt field displays remarkably perfect examples of the phenomenon known as the mirage. Beautiful flowering fields, sylvan

many people obtain their living by gathering salt. The process is to prepare a series of shallow pools near the ocean and below the level of high tide. Channels are cut by which the ocean water can enter these pools, and the channels are then dammed up so that the water cannot flow out when the tide recedes. After evaporation has left the ground white with dry salt, it is raked into heaps and hauled to the place of shipment, while a new period of evaporation is passing in the refilled pools.

In New York, northern Michigan, southern Kansas, southwestern Ontario and several other regions of North America, there are underground deposits of rock salt of great value. The usual process by which this salt is obtained involves the boring of wells deep into the strata of salt. These wells fill with water, either from the surface drainage or underground springs, or are pumped full, and the water dissolves the salt until it is saturated and becomes a brine. Then it is pumped out and evaporated in great kettles. In several European countries there are mines of rock salt, extending far underground, which are worked by shafts and tunnels in the earth, just as coal or iron mines would be. Austria and Russia have mines of this character, and they are considered among the most interesting of all the underground industries.

Mexico in several places has salt deposits similar to those in southern California,

although none so extensive. Indeed, there is hardly a country in the world which does not contain salt deposits of some sort, even if in some instances they are no more than flowing springs impregnated with this important substance.

When we say salt we mean, usually, chloride of sodium or common table salt. This, however, is but one of many soluble salts contained in the ocean and in the salt seas of the world. Even in fresh river water some mineral salts are present. Of these a part may be removed by various means during the journey of the river, but the rest remains to be concentrated at last in the basin in which the river comes to an end. Of course in most instances the ultimate outlet of the rivers is the ocean and when this is not the case whatever outlet is final is sure to be salt.

There are not very many salt lakes in the world, or lakes without an outlet. North America has one such important



PLOWING FURROWS IN THE FIELD OF SALT.

lake, the Great Salt Lake of Utah, into whose basin drain a number of rivers included between the Rocky Mountains and the Sierra Nevadas. Asia has two or three of the same character, notably the Caspian Sea, which is the largest land-locked body of water on the globe, and nearly five times as large as Lake Superior. Lake Balkash, the Sea of Aral and the Dead Sea are others in the Asiatic continent, the latter being one of the few at a lower level than that of the salt deposit in southern California.

It would be easily possible indeed for this American salt field to become another Dead Sea. It lies far below the level of the ocean, as has been said before, and the Colorado River, which carries a considerable stream, is several hundred feet above it and not far away. In the summer of 1891, indeed, there was a flood in this river and a large area near Salton became a lake of considerable depth. When the river flood subsided, however, so that the supply of the lake was cut off, the rapid evaporation from its surface soon carried away the water, and left it in its former condition.

The saltiness of the sea is evidence of its power of transportation if not of destruction, for at least a very large part of the salt is brought down into the sea by rivers. This, however, must be uniformly distributed by diffusion or by currents, for ocean water is practically the same composition in all parts of the globe. True, it is a little more salt in warm regions than in cold, but this difference is due to the greater amount of evaporation. For a time, also, it is more brackish, at any rate near the surface, in the neighborhood of the mouth of a large river. That the mineral substances must

be mainly if not wholly brought down in solution by the rivers, is proved by the fact that every sheet of water for which there is no outlet is salt. Evaporation cannot remove the salt constituents, which are present in greater or less degree in every stream, so they remain behind and the water very slowly but very surely becomes more salt.

There was a time, as is proved by the character of the fossils which are found in beds high above the present level of the water, when the Dead Sea was but slightly brackish. The ocean, also, may be more salt at the present time than it was when the world was young. It would become much more so if countless millions of minute organisms were not ever drawing from it the supplies which are needed in the construction of the solid parts of their bodily frames.

The Dead Sea is recognized as the most fully impregnated with salts of all the bodies of water in the world. Less than 74 per cent of its entire bulk is water, and more than 26 per cent is of salts held in solution. Chloride of sodium, however, or common salt, is not the dominant salt, chloride of magnesium being 16 per cent of the total bulk of the sea, while common salt is but $3\frac{1}{2}$ per cent. Our own Great Salt Lake, in Utah, stands at the head of all in the amount of chloride of sodium in solution, with nearly 12 per cent dissolved in it.

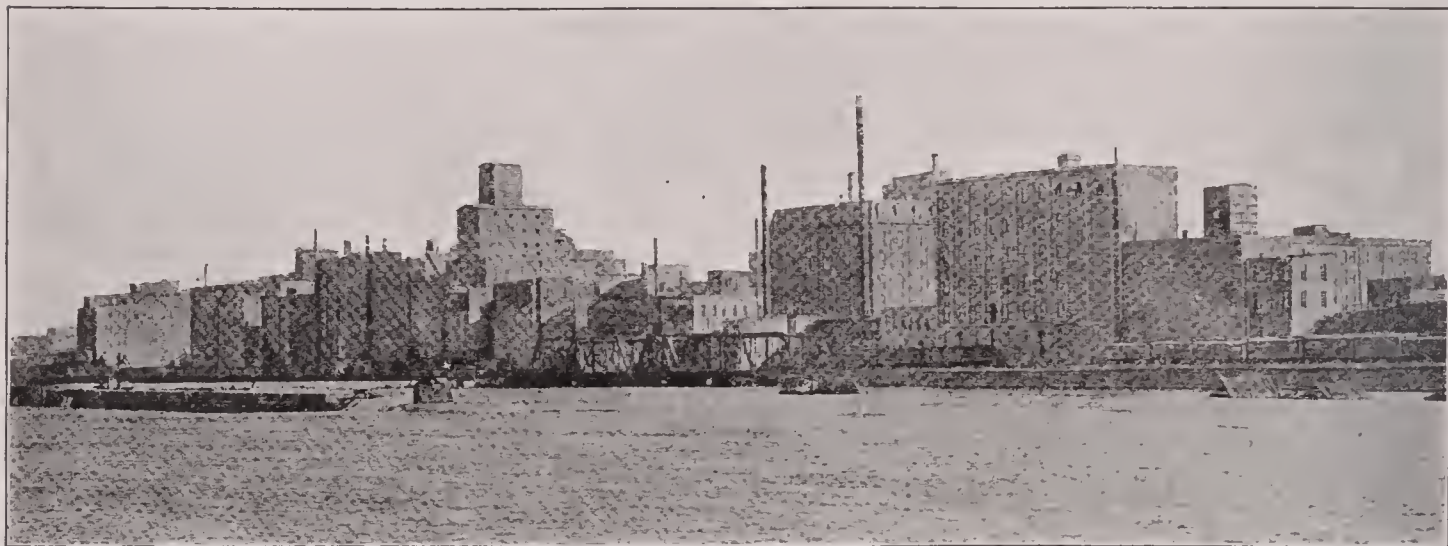
It is this large proportion of salt in the water which gives to the Dead Sea and the Great Salt Lake their extraordinary buoyancy. In these bodies of water it is absolutely impossible for the human body to sink, and difficult to swim, so dense is the saline fluid.

FLOUR AND FLOUR MILLS

It is an ancient saying that bread is the staff of life, but in ordinary justice it seems as if something ought to be said of the flour from which the bread is made, and the wheat which is ground into flour. Flour mills have changed greatly in character in the last few years, not only in this country but in the other great milling countries of the world, of which Hungary stands second to the United States. Immense milling companies have established their great enterprises in the cities of the great lakes,

wheel outside, and sometimes a windmill flapped its gaunt wings in the air above. The wheat in passing through the processes was carried from one machine to another in bags, and the flour which finally poured from the bolting reel was brown and coarse.

It was not until as late as 1877 that American millers grew discontented with the old rude buhr stones and began experimenting with a new roller-process which had recently been invented in Europe. Since that time the industry has taken wonderful strides, until today it may be numbered among the exact sciences.



FLOUR MILLS FACING THE MISSISSIPPI RIVER AT MINNEAPOLIS.

the upper Mississippi Valley, and the northwest, producing flour from a single mill sometimes as rapidly as a thousand little mills of the olden time would have done. Minneapolis is recognized as the greatest flour-milling city in the world, with Budapest as a close rival.

Half a century ago every little village in the land had its own flour mill, and the wheat was ground for the farmers in grists of a few bushels each. Sometimes the crude grinding stones whirled in response to the throbbing and splashing of a water-

The grinding of wheat by the most improved methods is a continuous process. The wheat enters the cleaning machines at the top of the mill, and passes steadily downward until it spouts in the form of flour of several grades, bran and shorts, from the chutes in the basement. The mill has three different classes of machines for doing its work, each marvelously adapted to its purposes. First, the wheat is cleaned by means of various fans and brushes. Then it is crushed several different times between delicately corrugated iron rollers,

one of which moves faster than the other. The last process is that of separating the crushed wheat into its different products, and this is accomplished by means of skillfully arranged sieves, bolters and air-blasts.

When the wheat reaches the mills it is run from the cars into the tin carrying-cups of an elevator belt, which lifts it to the top of the building and dumps it into the bins. As fast as it is needed it is let out by means of spouts into the machines, and begins its course downward.

It shakes in a slow, steady stream into the mouth of a device known as the wheat-separator and oat-extractor. As it falls downward a blast of air strikes it, and the chaff and light dirt are carried away; the wheat falls upon a sieve set at an incline and passes through the meshes. Grains of corn, oats and pieces of straw are too big to go through, and, as the sieve shakes, they rattle down to the end

and fall into a spout. After passing through three such sieves the wheat strikes a fourth in which the perforations are so small that only the bits of clay and small seeds go through, and the wheat itself is "tailed over" into a spout which carries it along to the cockle-separator.

The next machine is a cylinder in which a wire brush revolves very rapidly. As the wheat goes through, the fuzz at the end

of the kernel and every particle of dirt from the crease are wiped out and sucked away into an air-shaft. From this machine the wheat passes in a steady stream over some powerful magnets, which draw out any bits of iron wire, nails and screws which may have fallen into the grain from the harvesters or thrashers.

The wheat is now clean and ready to go downstairs to the rollers for crushing. There are five sets of these machines, in the first of which the spiral corrugations on the



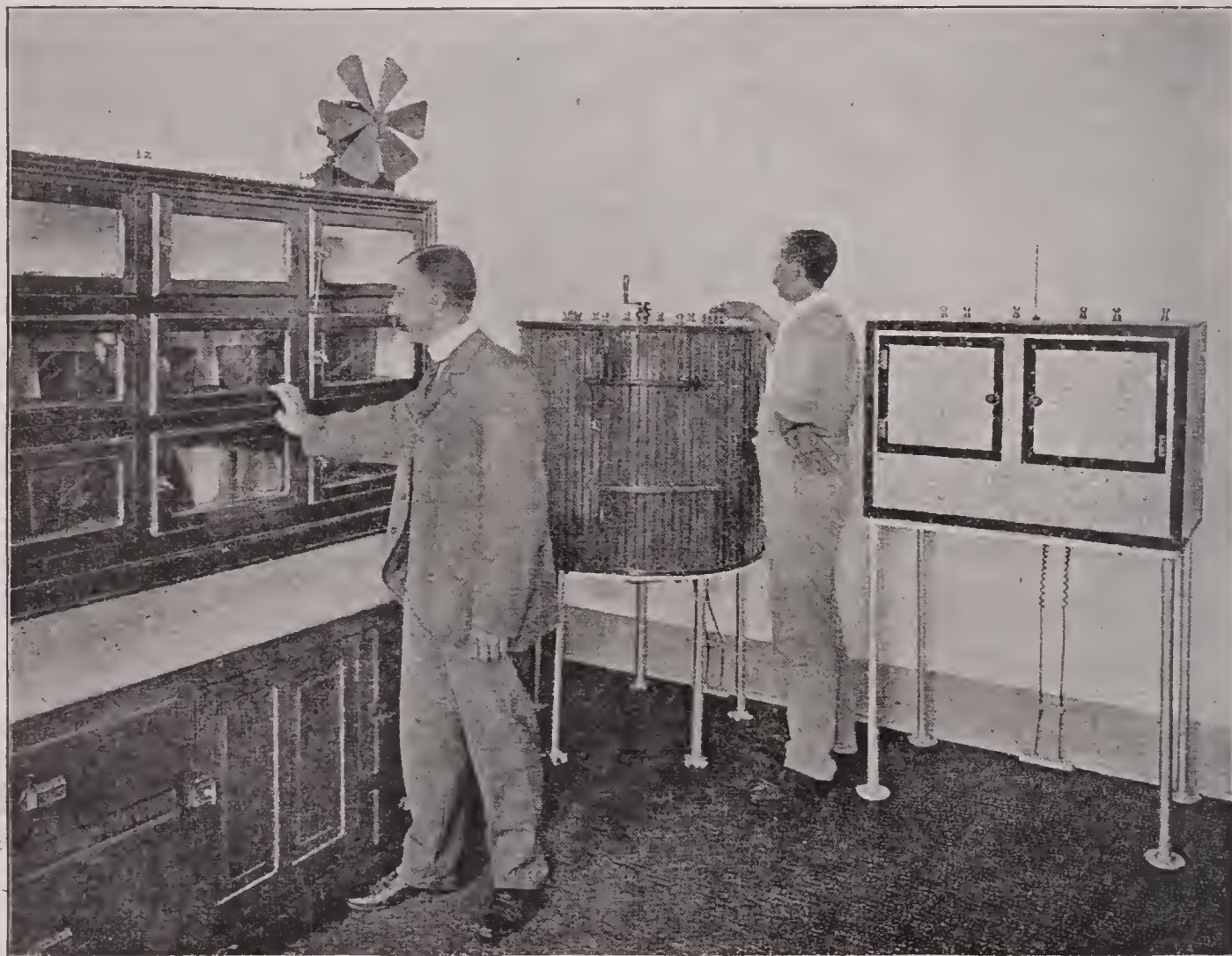
TESTING FLOUR IN THE LABORATORY OF A BIG MILL.

rolls are comparatively coarse, so that the wheat in passing through will simply be broken open longitudinally. The rolls of the other sets grow progressively finer in corrugations, and are set much closer together.

From the rolls the crushed wheat goes up to be "scalped." The machines used in most mills for this purpose are centrifugal reels or bolters covered with wire cloth and

silk gauze, the meshes in which vary in size for the wheat from each set of rolls. The crushed wheat is thrown at the sieves by centrifugal force, and many impurities are removed. A new German machine, known as the plansifter, was introduced in a Chicago mill, and since that time it has been adopted by many first-class millers. It consists of a long, flat box full of sieves set at

The middlings, or crushed wheat, is now carried on to the middlings purifier, the invention of which a few years ago revolutionized the whole art of milling. Its work is to remove the impurities and bran from the flour. It accomplishes this purpose by subjecting the passing stream of middlings to air blasts of varying force. The light dust and bran are carried upward and



BAKING BREAD BY ELECTRICITY.

an incline, and perforated with graduated meshes. The whole device is given an eccentric motion by being fastened a few inches at one side of the center of a great wheel. By this means of jolting it the crushed wheat is rattled through the sieves and graded according to the size of mesh through which it passes.

caught in little pockets, and the purified middlings pass back to the second set of rollers, where they are crushed again. This circuit of processes—the rollers, the plansifter and the middlings purifier—is repeated five different times and the separation and grinding is then complete. The flour from the last process is carried down-

stairs, where it runs into sacks and is tied up ready for the market.

One of the most important machines in a mill is the dust collector. Before it was invented the air of the mills was always full of flying particles of flour, which sometimes exploded with all the force of gun-powder. The dust collector consists of a fan, which, in creating a vacuum, sucks the flour out of the air and deposits it in a chamber by itself. This dust can be used in inferior grades of flour.

A barrel of flour will make about 260 pound loaves of bread. If the combined bakeries of Chicago use 2,000 barrels daily the number of loaves made is 520,000, which, at a retail price of 5 cents, cost \$26,000 daily. Probably as much more bread is made in the homes.

American flour is now used in almost every part of the world. A story is told of a traveler who visited the South Sea islands for the purpose of describing the terrible depths of barbarism in which its savage inhabitants were supposed to live. He secured an interpreter and began his explorations. When they reached the first bamboo and thatch village the traveler stopped on the roadside to experience feelings of wonder and exultation. He had heard that few white men had ever visited these particular savages, and like every person who believes his eyes behold unknown wonders, his spirits rose to a high pitch. He entered the village and was taken to the chief's bamboo hut. Just as he approached the door he was transfixed with amazement bordering on horror. There beside a long war club, the sword of a swordfish, and a primitive tom-tom, stood a real American barrel with a colored sign on the top advertising so-and-so's flour from Minneapolis, Minn.

According to the census of 1890 the number of flour mills in the United States was 18,470, with a capitalization of \$208,473,500. A total of 63,481 men were employed, and their wages reached the sum of \$27,035,742. The value of the wheat which they ground was \$434,152,290, nearly all raised in the western states, and the flour produced worth \$513,971,474.

The largest number of mills in any one state was 2,226 in Pennsylvania, but Minnesota, with only 307 mills, ground \$52,383,867 worth of wheat to Pennsylvania's \$33,238,981. The largest value of wheat used, next to Minnesota, was \$44,890,115 in New York. Then followed in regular order Ohio, Pennsylvania, Illinois and Missouri. Illinois had 647 mills, with a capital of \$13,101,860 and produced \$37,974,885 worth of flour in 1890. The census figures show that the products of the flour and grist mills of the country exceed in value that of any other single product from the raw material, even the iron, steel and lumber industries. The sugar-refining industry, which has caused so much anxiety on the part of congress, represents in value of annual products less than one-fourth that of flour-milling. The meat and packing industry, which seems so tremendous, does not produce as much as the flour-mills within \$80,000,000 annually.

A noticeable thing about the industry, is the fact that the village mill is gradually disappearing. The wealthy and powerful millers of the cities are slowly swallowing up the business. This is strikingly shown by the fact that according to the census of 1880 there were 24,338 mills in the United States with a capitalization of \$177,361,878, while in 1890 the number of mills had decreased to 18,470, while the capitalization had increased to \$208,473,500. If

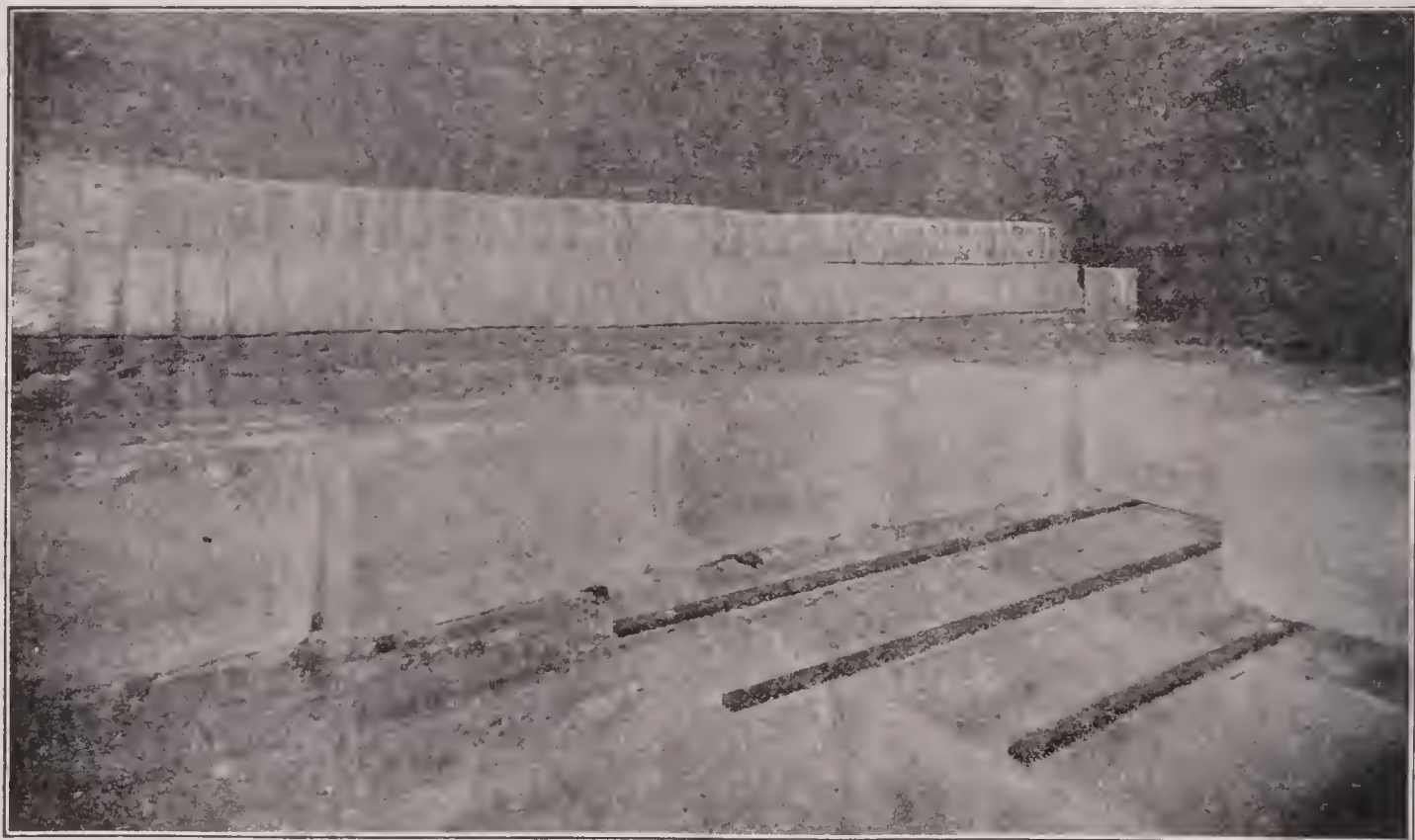
this startling change continues it will be only a few years before half a dozen millers will control the whole industry in the United States.



ICE, ARTIFICIAL AND NATURAL

There is no article more intimately associated with our genuine comfort in the hot, trying weather of midsummer, than ice, which is now so universally distributed as to be recognized as no longer a luxury

portant as to have its influence upon municipal politics and state legislation, and so profitable as to make fortunes for those who are engaged in it. In our northern states, nature by her own processes will make ice in the winter, enough to serve for the summer, if it is properly preserved, but in the southern states of our own country, and in the tropics, nature's gifts do not take this form, and man must provide cold things for himself. So it is that inventors have devised simple machines which by



ARTIFICIAL ICE IN STORAGE.

but a necessity. Ice is an essential factor for health and comfort, particularly in the cities, where people live crowded together, and the refreshing conditions of rural life are not at hand. The result of this wide use of the transparent blocks of frozen water is that for its preparation and distribution an immense industry has grown up, so im-

chemical and mechanical processes produce ice at little cost, whether it be on the equator or not. So excellent is the ice thus frozen that great ice-manufacturing companies have been established in the northern cities as well, competing in price and quality with those companies which distribute nature's own product.

It is an old scientific trick to freeze water in the fire, by wrapping a small bottle with a rag soaked in ether or chloroform. The heat of the fire evaporates the volatile ether so quickly that the ether sucks the heat out of the water and freezes it. This is practically what the icemaker does, only he uses ammonia or sulphurous oxide, instead of ether or chloroform, and works on a big scale with large pumps, steam engines, and miles of iron pipe.

At ordinary temperatures ammonia is a vapor or gas. The ammonia which is bought at a drug store is really ammonia water, for it is a water in which ammonia gas has been dissolved or absorbed. The icemaker uses ammonia gas, sulphurous oxide—which is the choking, suffocating fumes given out when sulphur is burned—or ammonia water, according to the system he employs. Anhydrous ammonia is ammonia without water in it, and the icemaker who uses ammonia, buys anhydrous ammonia.

The whole story of artificial icemaking can be told in a paragraph, for it is simply permitting pure liquid ammonia to evaporate or expand inside of iron pipes which are coiled in tanks filled with salt brine, which gives up the heat required by the ammonia in evaporating, and thus lowers its temperature below the freezing point. The fresh water is in smaller cans which are surrounded by the brine, and is frozen, for the brine does not freeze even at zero.

But to do all this, expensive, heavy and special machinery must be employed, and the combination of steam-boilers, pumps, condensers, tanks, pipes and other machinery gives a complicated appearance to an artificial ice plant which is confusing.

The great pump is the principal piece

of machinery in the ice-making establishment. It performs a double office, for with one stroke of the piston it sucks in the anhydrous ammonia gas, and with the next compresses the gas to a liquid, for the anhydrous ammonia is used over and over again, first as a liquid, then as a gas, freezing water, and back as a liquid again. The ammonia gas is liquefied not only by pressure but also by cold. In an ice-making plant both are used. The pump forces the gas into the condenser, which is a series of coils of small pipe over which water is constantly flowing. The gas, pressed into the smaller pipe, turns to liquid ammonia. As it condenses, the liquid ammonia flows into a storage tank through small pipes leading from the condenser. All this time it is under pressure which forces it along, so that the liquid ammonia flows from the storage tank, which is placed in a horizontal position, into two large vertical cylinders, and from there into the expansion coils, which lie in the bottom of the expansion tanks. The pipes of the expansion coils are much larger than the pipes which make up the condenser, and the liquid ammonia expands and evaporates as it moves along, keeping the salt water or brine in the freezing tanks at a temperature of 18 degrees or colder.

All this time the big pump is pushing the liquid ammonia along, and sucking the ammonia gas back again, so that the ammonia, whether gas or liquid, is moving around, condensing, expanding, freezing, condensing again, expanding again, freezing again, and so on.

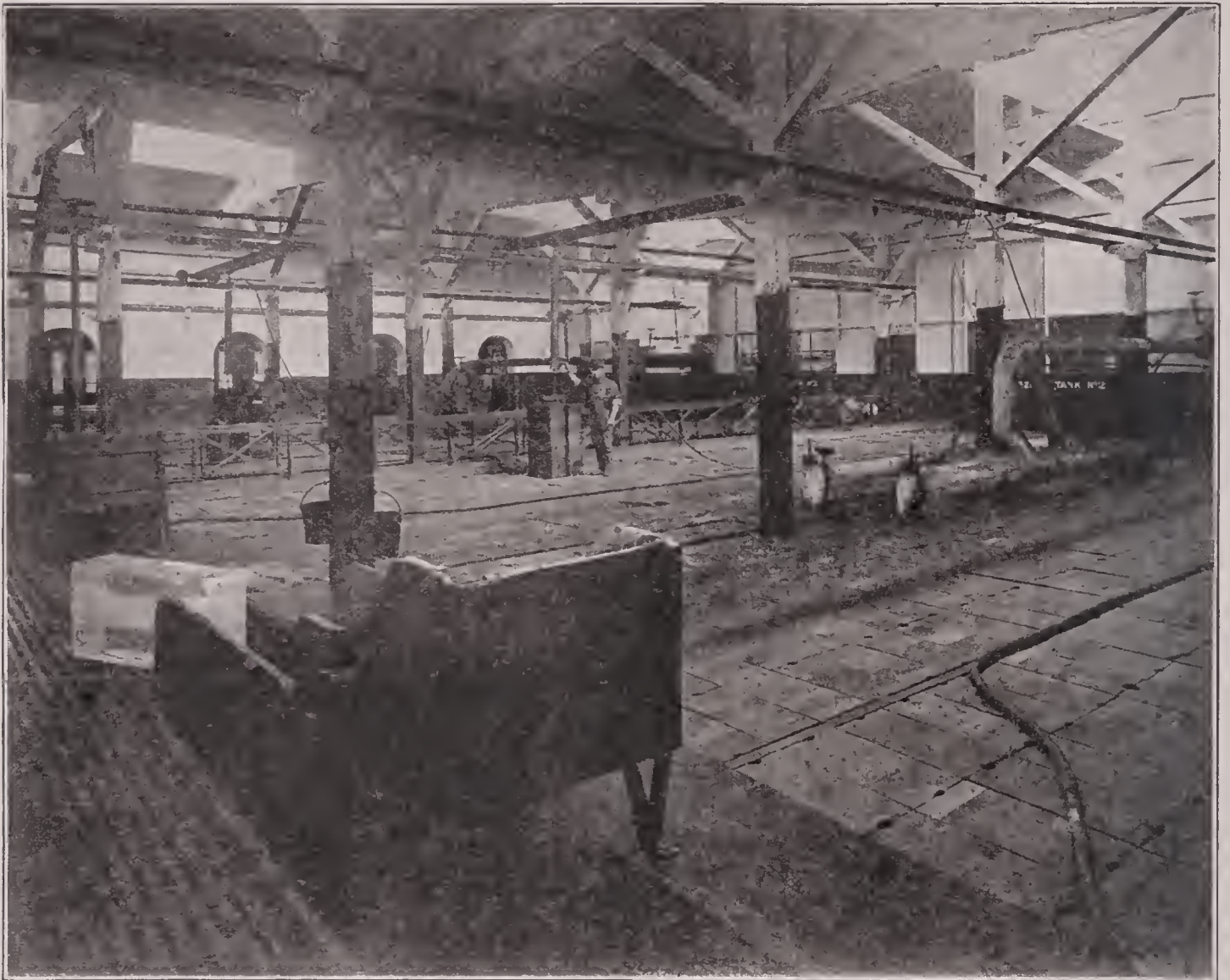
In making artificial ice the manufacturer wants pure water. To be certain that the water is free from sediment, typhoid germs and other impurities he filters and distills

the water before it is frozen. In some ice works the water is filtered once before it is distilled and twice afterward.

The freezing tanks are made of iron. They usually are set below the floor, for the purpose of facilitating the handling of

is kept in motion by an agitator somewhat like a screw propeller. This gives the brine an even temperature. It requires from forty-eight to sixty hours to freeze the water in one of the cans.

The cans are covered while the water is



FREEZING TANK ROOM IN AN ICE FACTORY.

The tanks are shown in the floor, each with rings by which they are lifted.

the ice. The tanks are about 50 feet long, 20 feet wide and 4 feet deep. The cans in which the distilled water is frozen are 44 inches by 22 inches by 11 inches in size. The pipes which contain the anhydrous ammonia go back and forth across the tank between the cans, and the salt water brine

freezing, so that the whole process of freezing is really going on under the floor, for the covers are the plates of the floor. Over the freezing tank is a traveling crane, with a block and tackle for hoisting the cans with the frozen blocks out of the tank. The cans are lifted so that when they are clear of

the tank they tilt upside down. They are then carried by the traveling crane to the head of a gangway which runs into the icehouse. Here streams of tepid water are directed upon the can. In a few moments the ice holding the cake to the can melts, and the block of artificial ice slides out of the can and down the gangway. The can is then taken back, filled with water, and dropped into the tank again.

Where shafts or tunnels go through quicksands artificial refrigeration is sometimes used to freeze the treacherous material. The anhydrous ammonia plant is on the surface or at the mouth of the tunnel, and from it brine chilled to zero is sent through pipes to the place of working. Pipes are driven ahead of the work into the quicksand, and the circulating brine freezes the loose ground into a hard cylinder. The work is then carried on through this frozen material, which shuts out the quicksand until the brick is laid in.

Fortunately nearly every city and town has some lake or river near by where ice can be cut in winter. The lakes of Michigan, Wisconsin and Minnesota, filled with pure water as they are, furnish a large quantity of the ice used in Detroit, Chicago, Milwaukee, Minneapolis, St. Paul and the other smaller cities within their territory. During the winter season busy scenes may be observed at these lakes, which are the favored resorts of multitudes of summer visitors in vacation time. Their frozen surface is alive with men and teams cutting the ice, rafting it to shore, and turning it over to the sleds that haul it to the railway for shipment to the ice houses.

There was a time when people were more careless about the health conditions of the food and its surroundings than they are

now, but it has come to be so clearly recognized that many of our bodily ills come from carelessness in the sanitation of our houses and in the freshness of our food, that people now scrutinize these details with great care. Ice made from impure water is no longer acceptable for our refrigerators or our drinking water. Laws have been passed protecting the public in this matter, and their rigid enforcement has assisted materially in reducing typhoid and kindred diseases.



IVORY, HOW OBTAINED AND USED

Every ivory billiard ball in use in the world is said to have cost the life of a human being. And still the demand for ivory, not only for the manufacture of these simple spheres for a popular game, but for a multitude of other uses in decorative and toilet articles, continues, with the price so high that the trade still goes on in spite of its disastrous cost in human life.

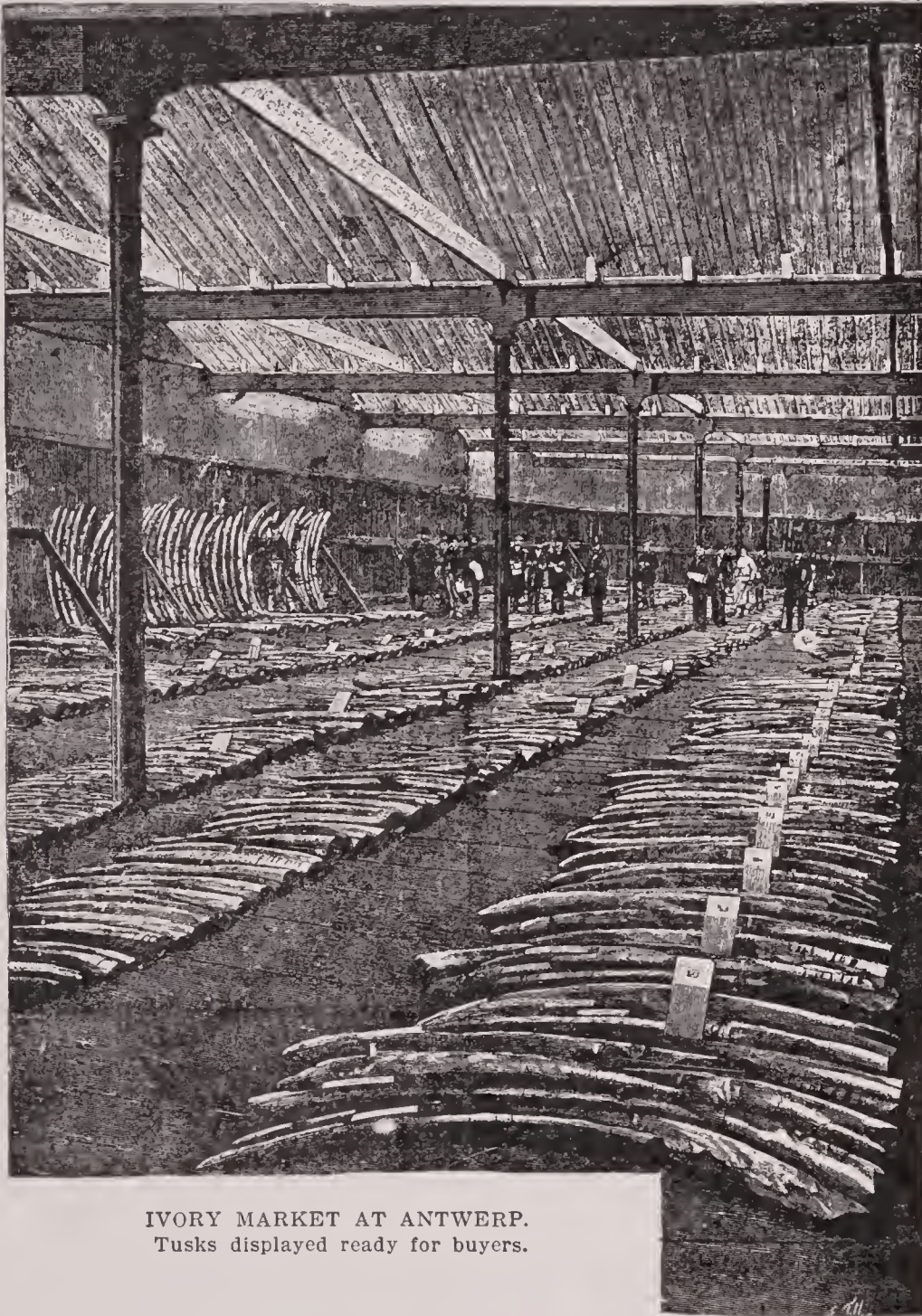
Most of the heavy expense has been paid in the jungles of central Africa, where a man does not count for half as much as a humped ox or a trained ape. For nature has built an effectual barrier about her cultivators of billiard balls—the elephants—and he who would penetrate it must take his life in his hands.

In the first place she has provided an atmosphere of great heat, reeking half the year with moisture, in which lurk the germs of a hundred unnamed diseases, and rent for two seasons with sudden storms accompanied by heavy rains. Then there is the barrier of a rank and tangled vegetation, through which no roads but those of the jungle-folk have yet pierced. The huge

trees conceal fierce wild animals, poisonous snakes, and insects whose stings mean death at the end of the days of suffering. Impassable morasses, lakes, broad rivers and mountain ranges are also numerous,

So the elephant is given a chance to grow a little before the harvesters of the ivory crop can reach him. When he has trumpeted for a few score of years, and his tusks have made him a power in the herd, some

native hunter spies him as he thrashes through the jungle or wades in a morass. Then a great number of the bravest warriors gather and build a huge inclosure of vines, into which the elephant one day walks. From the surrounding trees come a shower of arrows, and perhaps a bullet or two from an ancient gun obtained at a hundred times its value from some wandering trader. The elephant charges about trumpeting, but on every side the barrier holds him in. At last he falls, overcome by numbers. Then his great tusks are packed away, and a row of naked natives carry them for days through the jungle, until they are placed in the king's treasury as a part of the



IVORY MARKET AT ANTWERP.
Tusks displayed ready for buyers.

and yet more dangerous are the jealous savages, who have learned enough of civilization to distrust it, and who know that a man never protests against robbery after he is dead.

wealth as well as the currency of a nation.

After a time traders from England and from other countries appear, and the tusks are bartered for bright nothings, old-fashioned and shop-worn fabrics, food, whisky

and firearms. There is another long period of transporting the precious ivory on the backs of natives, with the constant danger of attack from hostile tribes and the treachery of friendly ones. At last it is aboard ship, and after weeks on the sea it arrives at the great ports where it is sold to carvers and manufacturers.

The best ivory comes from Africa. Some of the tusks are from eight to ten feet long, and often weigh 170 pounds. The Indian elephants' tusks are much shorter and of less weight, and the great demand has reduced the supply to such an extent that it is now rare to find a large tusk. Indian ivory is not so good in quality as that from Africa. Much of the ivory used in Russia and other parts of Europe is found in northern Russia and Siberia, in the remains of prehistoric mammoths. Where the skeletons have been always frozen in the earth, the ivory is as good as the ordinary Indian product, but much of it has been injured by exposure to the weather. Tusks have been found which were more than 12 feet long and weighed upwards of 200 pounds.

The value of ivory rests mainly in its toughness, its elasticity, and its quality of taking a high polish. It is filled with millions of minute holes which give it an elasticity which no solid object could ever have. In effect ivory is the same substance as the dentine of the teeth, and it is unlike bone in having no channel for the passage of blood. The teeth or tusks of the narwhal, sperm whale, walrus, and hippopotamus are also used as ivory, but the quality is usually poor.

Great skill is required in buying tusks, for the external appearance is most often deceptive. The inside may be full of ab-

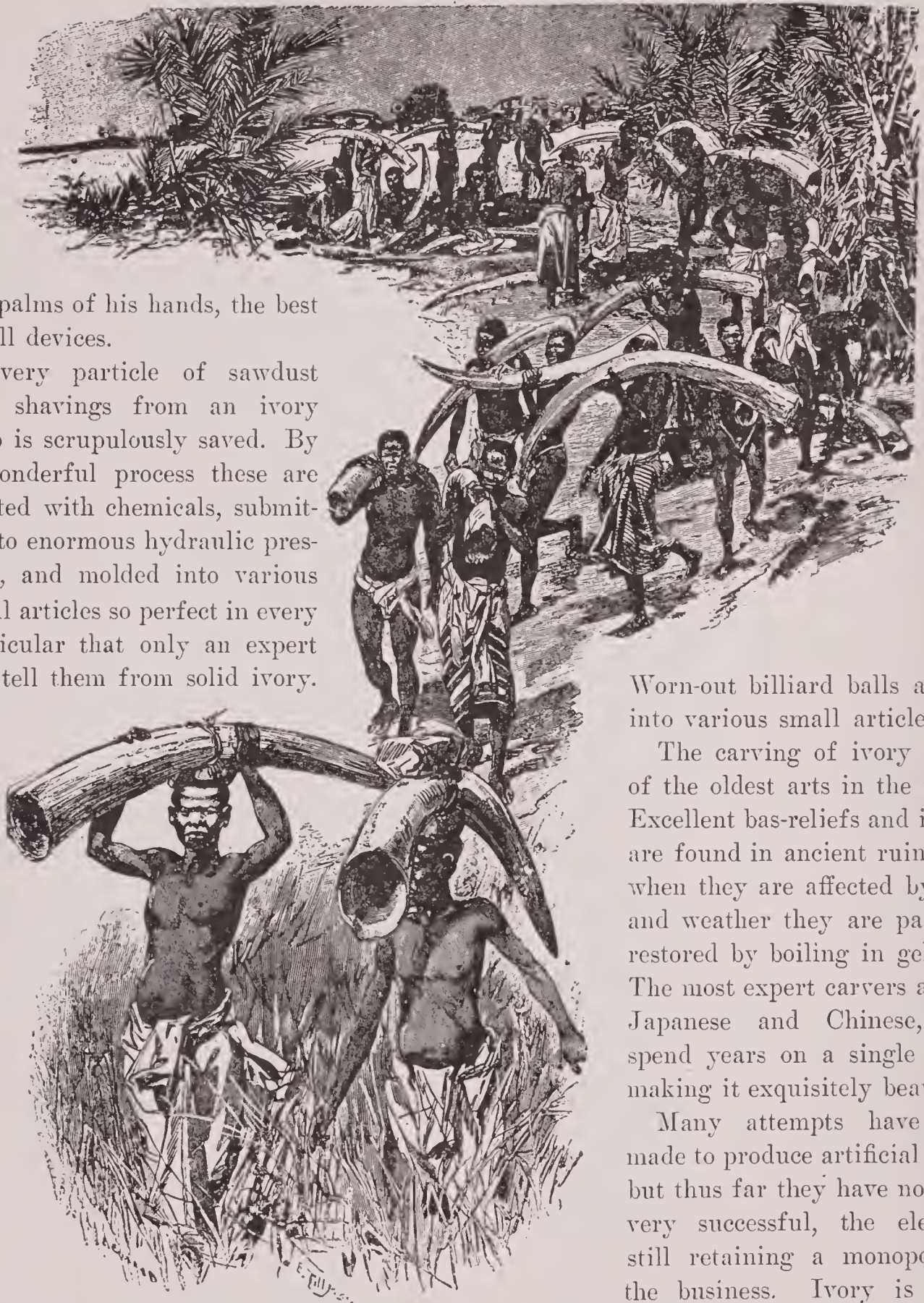
scesses and cracks, and sometimes the core is filled with pieces of stone and chunks of iron by the tricky natives and no less tricky dealers.

When at last the tusk reaches the manufacturer of billiard balls it is again examined very carefully for flaws, and even if the smallest crack is perceptible the ivory is used for some other purpose. If the tusk is found to be perfect and of about the right size—a little larger in diameter than the ball is to be—it is sent out to the workroom. Here workmen measure the tusk into the proper distances to be cut into blocks. It is then sawed into lengths of two and a half to three inches, according to the size of balls to be made, and the turners take the blocks in hand. In order to save the corners of the blocks the turner cuts a ring at each end and slowly deepens it until a rough ring drops off. This is subsequently finished into a martingale ring like those used on expensive harness. Two rings come from each billiard ball block. The remaining ivory is now almost round, and after a few more shavings are taken off it is laid aside to dry for about six months, for "green" ivory is rather soft, and there is always a likelihood of some shrinkage.

When it has been seasoned it goes to the workman again, and with still more delicate chisels he pares it down smooth and exactly round, a task requiring much skill and care. Then the ball is roughly polished by means of an ingenious little machine, after which it is treated to a rubbing with chalk and chamois skin, and finally with plain, soft leather. It is now bright, shiny, and to one who doesn't know about such things, perfectly smooth. But a workman spends much time rubbing it with

the palms of his hands, the best of all devices.

Every particle of sawdust and shavings from an ivory shop is scrupulously saved. By a wonderful process these are treated with chemicals, submitted to enormous hydraulic pressure, and molded into various small articles so perfect in every particular that only an expert can tell them from solid ivory.



BRINGING IVORY FROM THE AFRICAN JUNGLES
TO THE COAST FOR SHIPMENT.

Worn-out billiard balls are cut into various small articles.

The carving of ivory is one of the oldest arts in the world. Excellent bas-reliefs and images are found in ancient ruins, and when they are affected by time and weather they are partially restored by boiling in gelatine. The most expert carvers are the Japanese and Chinese, who spend years on a single piece, making it exquisitely beautiful.

Many attempts have been made to produce artificial ivory, but thus far they have not been very successful, the elephant still retaining a monopoly of the business. Ivory is growing more costly and more rare from year to year, and it is only

a question of time when the sources of supply will fail.

Until a few years ago London and Liverpool were the two great ivory markets of the world, but they have been outstripped of late by Antwerp. This is on account of the development of the trade in the Congo Free State, which is a colony of Belgium. The Antwerp market was opened less than ten years ago. The stock offered there for sale is remarkable not only for the great number of tusks, but also for the enormous size of some of them. Among those sold lately was a pair weighing nearly 350 pounds. A few days before the opening of the market the tusks, all laid out and numbered in lots, are placed on public exhibition in some great hall, as represented in the accompanying illustration, and the buyers come here to select what they want and bid for them.

The world's consumption of ivory is very large. The annual average quantity used is about 1,500,000 pounds. Taking into consideration the fact that in the wholesale markets such as Antwerp and London ivory costs on an average \$1.75 a pound, an idea may be had of its importance in commerce.

Unfortunately the future of this trade, which has caused streams of blood, is seriously threatened. The constant war waged upon the elephant on account of his ivory is bringing him nearer and nearer to extinction. The Congo Free State has occupied itself earnestly with this question, and has officially established a closed season and limited conditions, during which elephant-hunting is absolutely forbidden. It is also proposed to establish elephant farms in the Congo State, as has been done by the English with ostriches in South Africa.

OSTRICH FARMS IN AFRICA AND CALIFORNIA

When the demands of fashion for plumes and the careless slaughter of the great birds began to threaten the extermination of the ostrich, clever business men in South Africa decided to domesticate the valuable producers of the big feathers, and raise them more carefully, for profit. So it was that a new industry was created. Eggs were obtained and hatched, the young birds carefully reared, and though the first experiments were carried on at a loss, it was not long before the milliners of the whole world were drawing their supply of plumes from the ostrich farms of Cape Colony and Natal. The trade now has reached such proportions that in a single year ostrich feathers to the value of more than \$3,000,000 have been exported from South Africa. An illustration on page 420 in this volume shows a characteristic group of ostriches on one of these queer ranches near Cape Town.

When Americans saw the profit in ostrich farms, they promptly looked about to find a region in this country where the same industry could be established. In Southern California, Arizona and New Mexico they found favorable conditions, and now there are a score of large and profitable enterprises of the kind in operation in the southwest. The first birds and eggs were brought from South Africa, of course, but now they are bred here with entire success.

These ostrich farms produce a large part of the plumes used in this country. The feathers are plucked from the big birds once a year, the plumes bringing about \$20 a pound. These peculiar ranches are places of great interest for traveling strangers.



SANTOS-DUMONT AND HIS SUCCESSFUL AIRSHIP.

This is the famous craft known as "Santos-Dumont No. 6," with which the young Brazilian inventor made his famous voyage around the Eiffel Tower, winning the prize of \$20,000. In the small picture he is shown in the workshop where the airship was made, inspecting the bag, as he was careful to do with every inch of the whole vessel.

BOOK II

THE WORLD'S SCIENCE AND INVENTION

AIR-SHIPS A SUCCESS

More progress has been made in aerial navigation within the last ten years than there had been before in the century that had passed since the Montgolfier brothers invented the first balloon. The most distinguished success has been made by a young Brazilian, M. Santos-Dumont, whose experiments, continued at great expense and with untiring energy for several years, at last brought him international fame. During his experiments in Paris in the summer of 1901, the young inventor succeeded in driving his aerial ship a distance of ten miles in forty minutes, and performed evolutions which showed that he had his craft under complete control during the trial. Paris has always been the center of activity in aerial navigation, and a large club of aeronauts has helped to stimulate general interest in the conquest of the air. One of the members, M. Deutsch, in order to stimulate invention, offered a prize of 100,000 francs (\$20,000) for a successful balloon trip from St. Cloud around the Eiffel Tower and return in forty minutes. Various inventors worked for this prize, which was finally won by the young Brazilian, who gave the entire sum to the charities of Paris.

M. Santos-Dumont was born in Brazil in

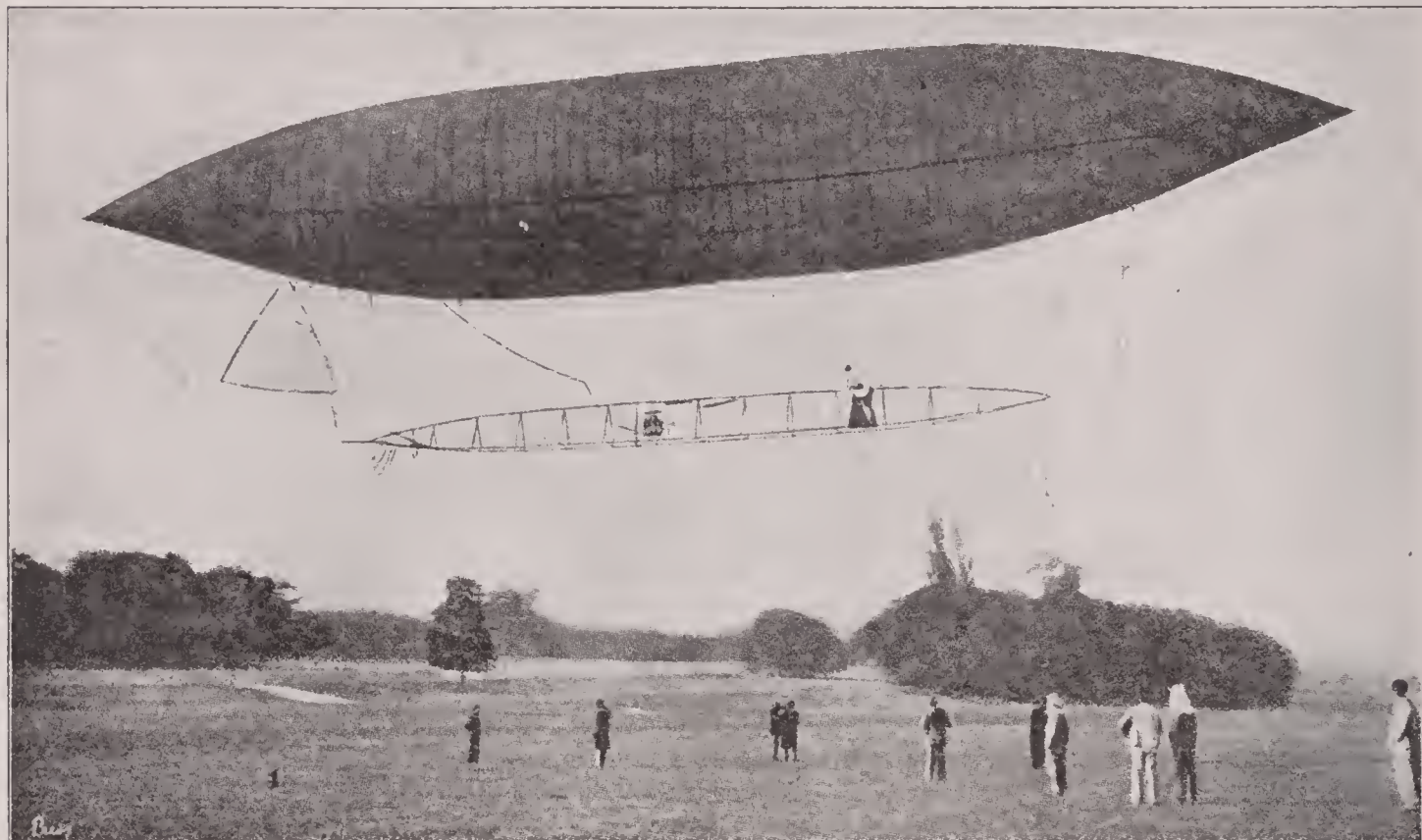
1873, and as a very young man became interested in aerial navigation. His first experiments were with spherical balloons, but he soon abandoned these for those of cylindrical or cigar shape, and his triumphant success was gained with the fifth he constructed. The balloon proper with which he won the large prize, was 111 feet long and twenty feet in diameter. Beneath the



ROUNDING THE EIFFEL TOWER.

balloon, suspended by steel wires, was a cradle fifty-nine feet long, composed of pine poles secured together at the ends and braced in skeleton fashion like the trusses of a bridge. This cradle contained a four-cylinder motor of sixteen horse-power. The screw propeller of the strange craft was at one end, and at the other the aeronaut sat, in a small basket, in reach of electric con-

after handful of sand, and the balloon slowly rose higher and higher. The rudder worked well, and the balloon was turned upon its course directly toward the Eiffel Tower. The daring navigator rounded the great structure at a distance of not more than 300 feet from it, and at a height of some 500 feet above the ground. He returned again to the park whence he had



THE SUCCESSFUL SANTOS-DUMONT AIR-SHIP.

This is the vessel in which the young Brazilian inventor sailed from St. Cloud to the Eiffel Tower and back again, a total distance of 10 miles in 40 minutes, the most noteworthy achievement in the history of aerial navigation.

nections which controlled the valves and rudder.

The start was made from the huge shed at St. Cloud, on the banks of the Seine River, near Paris. The sliding doors of the shed which sheltered the strange ship were opened at five o'clock in the morning, the craft was wheeled out into the open air, and the motor was given a turn. The ropes were cast off, the inventor took his seat in the basket, throwing out handful

started, without the slightest difficulty, brought the machine to the ground uninjured, and descended from his basket with the knowledge that he had outdone all his predecessors by this marvelous achievement. Never halting in his experiments, Santos-Dumont constructed another and yet another of his air ships, each an improvement on its predecessor, and continued his aerial voyages on the Mediterranean coast and at other places in France.

It was as a result of this triumph that the directors of the St. Louis World's Fair decided to offer large prizes for achievements in controllable air ships, to be exhibited at the Louisiana Purchase Exposition.

Inventors have been at work on the problems of aerial navigation for a long time, and the experiments, roughly speaking, have been in three directions. The balloon which supports itself and additional weight by the buoyancy of its contents, to be propelled by a motor and directed by a rudder, has been the favorite theory upon which to work. The true flying machine, which without buoyancy of its own should be supported and propelled as birds are, by an actual flapping wing-motion, is the second direction in which inventors have worked, and with less success. The aeroplane has been the third fundamental theory upon which inventors have labored. The kite itself is the most primary of the aeroplanes, supporting itself as it does, not by any natural buoyancy, but entirely by the pressure of the air against its surface. Three noteworthy inventors, Lilienthal, Maxim and Chanute, are best known in this line of experiments. They have worked in the same direction with a considerable degree of success. The idea is that a combination of plane surfaces, properly adjusted and balanced, would enable the navigator to remain in the air by soaring, just as a bird may do with outstretched wings.

The most practical use of balloons thus far has been made in warfare and in military experiments. The idea of using balloons in war is more than 100 years old, the first attempt made to put the project into execution being in France in 1794. Napoleon organized a balloon corps for his second campaign in Egypt, but before it

could be employed, the wagons containing the materials were captured by the British. During the siege of Paris in 1870, balloons were used extensively, and news was carried by that means from the beleaguered city to the provinces.

There is a military school of ballooning at Aldershot, where every balloon intended for the service is tested, where those whose business it is to use the balloons are instructed, and where all sorts of experiments are carried on. All the nations of Europe are engaged in attempting to bring the science of aerial navigation to perfection. It is no doubt a serious matter to consider that if ever the science were really made practical, the finest navy afloat could not stop the destruction of a city by a military balloon armed with explosives.

The latest improvement in war balloons comes from Germany, and experiments have been conducted in England with balloons of the same type. They are strange-looking objects, like a huge sausage floating in the air, instead of the familiar shape. Hitherto the wind has been the greatest difficulty to overcome in this science. Even a moderate wind was sufficient to prevent the huge sphere of the familiar type of balloon from rising to a great height. The new invention provides for an airship of great length and comparatively small diameter, floating at an angle of about 45 degrees to the horizon. It rises in the air on a slant somewhat like a kite, and a smaller balloon, towed astern of it, acting like the tail of a kite, assists in keeping the balloon in the desired position and helps to maintain its steadiness. Oscillation is largely obviated, and special advantages for photography are thus afforded. The basket is hung to the rear end, and from it extends

a cable which holds the balloon and the telephone wires by which communication is maintained. By such a captive balloon battles may be viewed from a distance, fortifications may be inspected, and other military objects may be attained.

No longer do scientists and mechanical engineers discredit the possibility of a practical flying machine or airship. Such a successful invention will be no more wonderful than other triumphs of genius which the last few years have seen, and it seems a reasonable prospect that we are on the verge of a successful aerial invention.

TRIUMPHS OF PHOTOGRAPHY

Photographs taken from a balloon high in the air, and showing clearly great commercial or landscape scenes, with a camera as large as a small room, are the latest developments of the photographer's art and industry. Views including thousands of men and women, actually recognizable by their friends, can be made when occasion demands. The progress of photography at this time is so rapid that one hesitates to limit its possibilities by any prediction.

Long before books were made, before even paper and printing were invented.



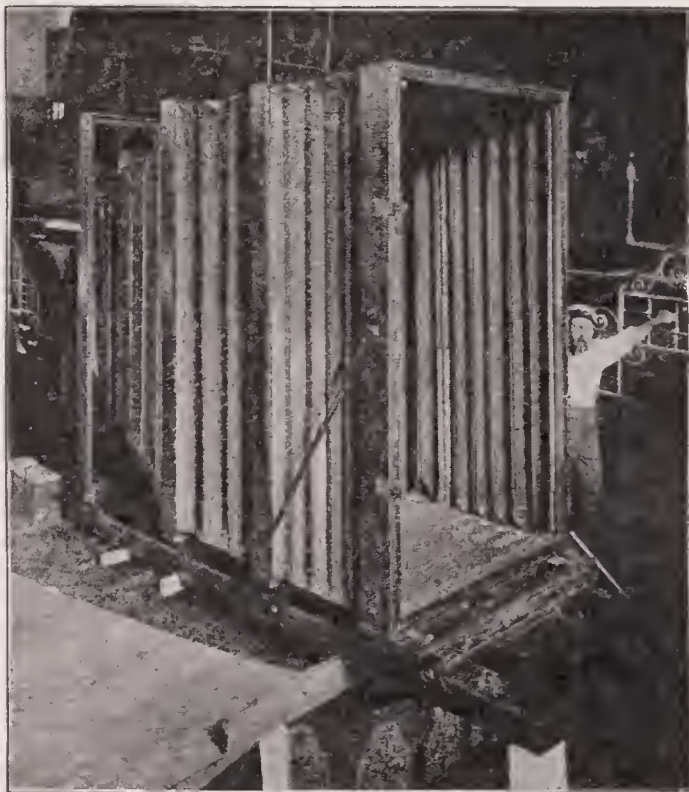
PREPARING TO TAKE A GREAT PHOTOGRAPH.

The view of the Chicago Stock Yards, taken from the balloon high in the air, is one of the most noteworthy achievements of photography.

back in the childhood of the race, primitive man recorded the events of his life and the manners and customs of the times by inscriptions carved in the face of the eternal rock. It was before the time of written words or even an alphabet. And so these early historians wrote their works in that most graphic of all manners, by making pictures. It is a self-evident fact that crude as are the drawings in stone that have come down to us through the ages, they give us a far better idea of life as it was than could be possible if instead of pictures they had merely described things in the simple words of a primitive language. Art is the universal language, understood by all, needing no translator for a picture of things as they are.

So it has been through all the ages and so it is to-day, that pictorial representations have been not merely an important adjunct to literature, but in many ways have surpassed it in the popular view. Descriptive matter combined with illustrations, presents subjects with clearness to the inquirer, but if only one can be chosen there are many instances in which the picture would tell the story better than would the text alone.

The first photograph made in England in 1802, or even the first product of the perfected apparatus in 1841, will hardly suggest the same processes that are used now in these most wonderful modern pictures. Within the last fifteen years of the nineteenth century such advances were made as naturally led up to the most conspicuous triumph of all. The old wet plate or collodion process of photography, with its slow exposure, was superseded by the dry plate, rapid in action and convenient to handle. Two dozen dry plates could be



THE LARGEST CAMERA EVER MADE.

handled with more ease than a single one of the old-fashioned kind, and so amateur photography spread until hand cameras became almost as common in the household as stereoscopes used to be. The invention of the transparent film of celluloid, wrapped in black paper and wound on a spool like ribbon, so that it could be placed in the camera by daylight, made it possible to do away with glass plates for photographs, and travelers consequently could provide themselves with material for a thousand pictures, more easily than for two dozen under the old regime.

To-day photography is recognized alike as an industry, a science, and an art. The public demands photographic illustrations for its books and its magazines, remaining no longer contented with imaginative views, skilfully painted, drawn or engraved by a fallible artist. Nature has become the one acceptable illustrator. At the behest of the photographer, by his lenses, his sensitive

plates, and his paper, the sun itself imprints the image of whatever scene is to be recorded, and gives it to us with the certificate of nature's truth. Such a work as the volume in hand, illustrated as it is by hundreds of photographs gathered from all the world, could not have been produced at all except by the aid of this graphic art. With the best illustrations possible otherwise, it would have cost many times as much as it does, while being in no degree comparable with the work as it now stands. So it is that the industry and art of the photographer, and the science of the inventive genius which has developed the camera, make it possible to bring to every reader a clear perception of the great and interesting things of all the world in such a form.

To-day every land is the scene of the photographer's labors. The explorers who make a dash for the north pole, they who penetrate the jungles of Central Africa, and they who surmount the highest peaks of the Andes, in every instance depend on the camera as a truthful witness of what is found. Great historical occasions, political events, commercial scenes, all are the subject of photography. Books of natural history, formerly illustrated by conventional drawings from stuffed birds and animals, now have photographic representations of the wild creatures of the forest, taken in their own habitat, by patient, wary lovers of nature. Such great institutions as the Chicago Stock Yards, large business offices and factories, immense popular gatherings and the like, many of which are included in this volume, are now the subject of the photographer's skill. Is it not a manifest fact that we would know far more about the life and manners of our ancestors, their homes and their cities even

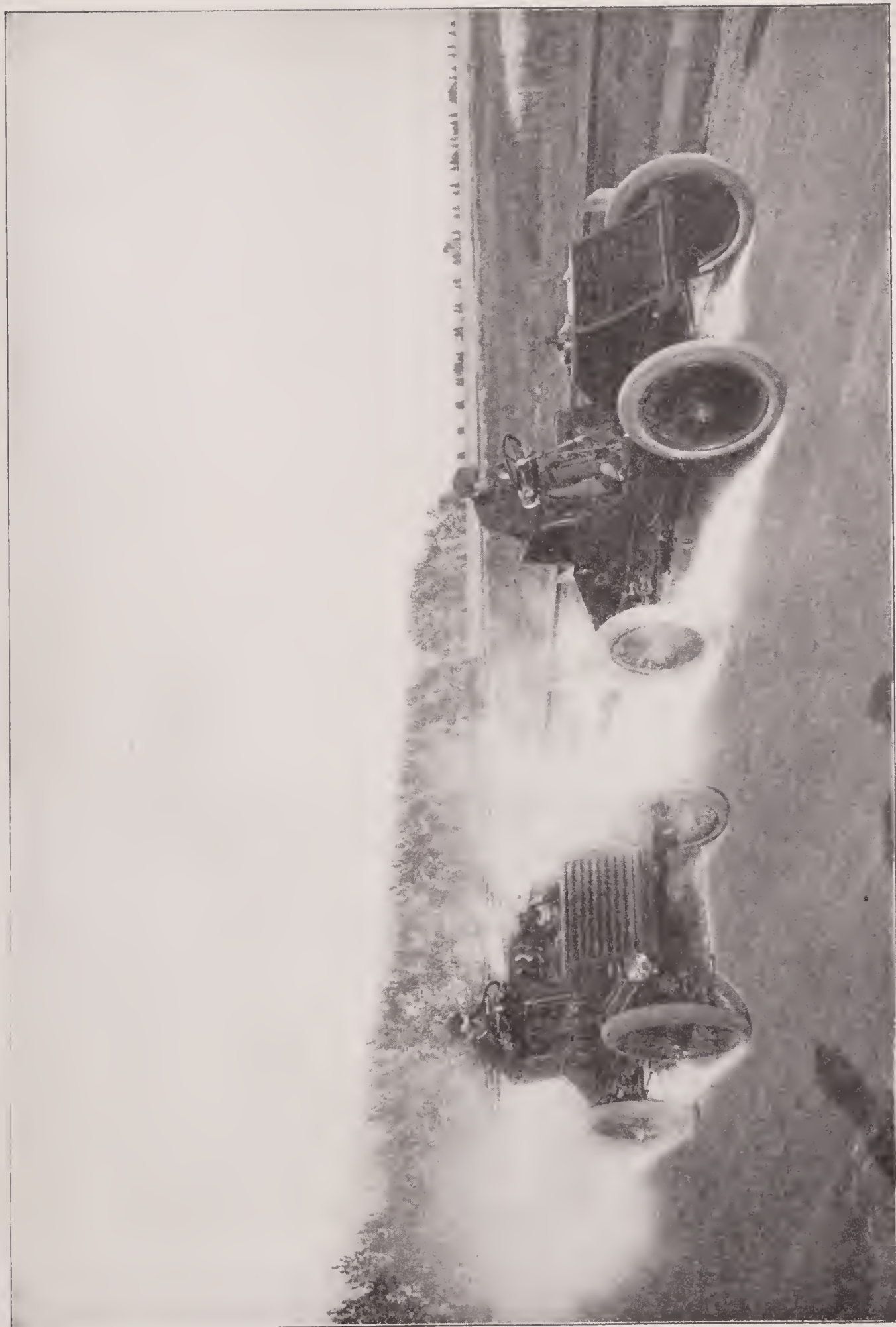
one century ago, if an art thus developed had been at their command, by which they might have left true records in pictorial form? Is it not likewise true that our descendants a hundred years later, by means of such collections of photographs, will have a clearer view of the world as it is to-day than they could have by any other record that we can leave to them?

The great camera with which these large-



READY FOR A FARM PICTURE.

Showing the great camera on a specially erected tower, with a range of many miles.



THE MODERN CHARIOT RACE.

Photographed on the Grosse Pointe race track near Detroit, when Alexander Winton of Cleveland drove his automobile ten miles in eleven minutes and nine seconds. Mr. Winton is ahead, nearest the fence.

est views are taken, measures eight by four and one-half feet, and one sensitive plate for a single photographic exposure costs \$500. For bird's-eye views of cities, farms, industrial and manufacturing plants, railway yards, stock yards, and the like, where no suitable elevation exists, a balloon is used to hoist the camera and the photographer far above the earth while he takes the picture. Farm views of property for sale are used by agents in the finding of buyers, and such views are likewise becoming popular among farmers themselves who take pride in their property. For such a picture, the camera may be mounted high in a treetop. Great business concerns use such photographs to advertise their enterprises, and thus photography in this most striking development of the art, becomes a recognized industry.



THE AUTOMOBILE AND ITS DEVELOPMENT

Automobiles have become so common in the streets of the larger American cities, that except when some novel design makes its first appearance there is no longer any special attention given them as they pass. The bicycle itself became a familiar sight hardly more rapidly than has the automobile, in the very few years since it was put on the market as a practical road machine. Scientists and inventors have been busy perfecting the various power-appliances and running-gear utilized; capitalists have hurried their investments into great manufacturing for the construction of self-propelling vehicles, and the public has been prompt to respond to the attractions of the swift and comfortable conveyance as perfected by the energetic business concerns

that placed them on the market. The striking rapidity with which these contrivances have come to be used, and the manifest possibilities which they have in their perfected forms, have created a phrase "the Horseless Age," for these years of activity in such inventions.

Ever since the steam engine itself was invented and the locomotive adapted from it, there have been efforts made to build practical self-propelling road machines which would not require a track. Heavy traction engines and steam rollers for road improvement have been quite generally employed, but they have never taken such a form as would make them available as passenger or pleasure vehicles. About 1890 French inventors turned their attention in this direction, and till a few years ago virtually all the progress that had been made was in France. Then American energy and ingenuity likewise became interested, and since then France and the United States have been rivals in the race for improvement in automobiles.

Thanks to the larger leisure class of wealthy men with time and money for experimentation and touring, automobiles have multiplied in France far more rapidly than in this country. In 1899 there were but 1,672 of the "horseless carriages" in France. One year later there were 5,286. In 1901 the number was above 9,000, and the increase still continues with the same rapidity. Of course the uniform excellence of the roads throughout France and most of the other European countries helped to advance the development of the motor carriage. With us, except in limited districts, the country roads are not such as to encourage touring, and the vehicles consequently have been confined to the cities.

The movement for road improvement and the rapid introduction of automobiles should be effective allies for each other. Good roads throughout the country will make the use of the automobile possible where now it is impossible, and the multiplication of such vehicles in villages and on farms will help to stimulate local pride for the improvement of the roads.

Self propelling vehicles, or automobiles, are now built in scores of patterns and are adapted to every sort of use. Light pleasure carriages, omnibuses, delivery wagons and heavy drays alike are seen on the streets of cities. In Paris the fire department uses an electric automobile, and in other cities the chiefs employ light vehicles for their own use in going to fires. The

mail is gathered for the postoffices of several of the larger cities by large wagons equipped with motors. Ambulance and ammunition wagons have been equipped with motors by the French military authorities, and railway hand cars driven by light gasoline engines are in use.

It has been difficult for designers to completely abandon the forms of vehicles that have developed under former conditions. One great trouble with the motor carriage, in the judgment of most critics, is that it does not get far enough away from its predecessors, and makes too evident the fact that it is really a "horseless carriage." Of late there is a tendency to more graceful designs, smaller wheels and less gearing.

For pleasure uses and for practical busi-



READY FOR A WINTER SPIN THROUGH THE COUNTRY.

ness it is necessary to provide a vehicle as light as possible for the necessary strength required. A cheap and reliable motive power, without noise and without odor, is likewise a requisite. Five or six different power mechanisms are used, of which electricity, steam and gasoline are the most popular. Compressed air and liquid air are also the object of experiments, with varying degree of success.

Henri Fournier, who is recognized as, perhaps, the leading automobilist of the world, prefers a hydro-carbon engine, and all his own road machines are thus fitted. With such a motor he rode from Paris to Bordeaux, a distance of 348 miles, eighteen miles of it through cities, in six hours, forty-four minutes and forty-four seconds. The 330 miles along open roads he covered at an average of fifty-three miles an hour, and for some of the way he was traveling at seventy miles an hour. The fastest train in Europe requires an hour longer to make the same trip. In a race from Paris to Berlin, 744 miles, he covered the distance in sixteen hours and six minutes. No such American speed records for such distances have been made, but for short runs some astonishing achievements are recorded. On November 16, 1901, at Prospect Park, Brooklyn, Fournier himself made a mile in fifty-one and four-fifths seconds, which is the world's record for a straight boulevard run. Three weeks before, all American track records up to ten miles were broken by Alexander Winton of Cleveland, at Detroit. His fastest mile was made in one minute, six and two-fifths seconds, while he covered ten miles in eleven minutes and nine seconds.

But the automobile is not merely a conveyance for speed and pleasure. In 1901,

a Chicago enthusiast made a cross-country tour of 2,600 miles over the typical American country roads, without once requiring the attention of an expert mechanic for his motor or his vehicle. The Sierra Nevada Mountains were crossed during the month of May, 1901, at a season when the snow-covered mountain trails were not considered fit for horse traffic. Pike's Peak, too, has been surmounted by at least one automobile. The hill-climbing capacity of the perfected machine is something astonishing. For city use the electric vehicle has been favored, because of its simplicity, cleanliness and silence. Equipped with storage batteries as it is, it must be recharged frequently, however, and consequently is not yet available for use throughout the country. As storage batteries are steadily improving and electric power plants are multiplying all over the country, this form of machine is certain to become even more available and popular. With the same battery the current not only operates the motor for the wheel, but also lights the lamps and rings the alarm gong. The machines operated by gasoline, either through a modification of the ordinary gasoline engine or by steam heated from a gasoline flame, are independent of the cities and charging stations, for that volatile liquid can be obtained for a few cents a gallon wherever one goes.

The expense of machines has been great enough to forbid their general use, ranging as they do all the way from \$600 to \$4,000. But as the machines gain in simplicity they reduce in cost. Already devices have been planned by which any vehicle may be temporarily converted into an automobile. A front axle carries a motor between its two wheels, and this axle may be attached to

any carriage or wagon as a substitute for its own equipment. With this appliance perfected, the farmer, for instance, with one of them, could change it from surrey or spring wagon to haycart or lumber wagon, and have as many automobiles at will as he had vehicles. It may be long before the phrase "horseless age" becomes even approximately true, but beyond question the applications of electricity and other motive power to a multitude of the uses where horses have been employed will work a great change within the next few years.

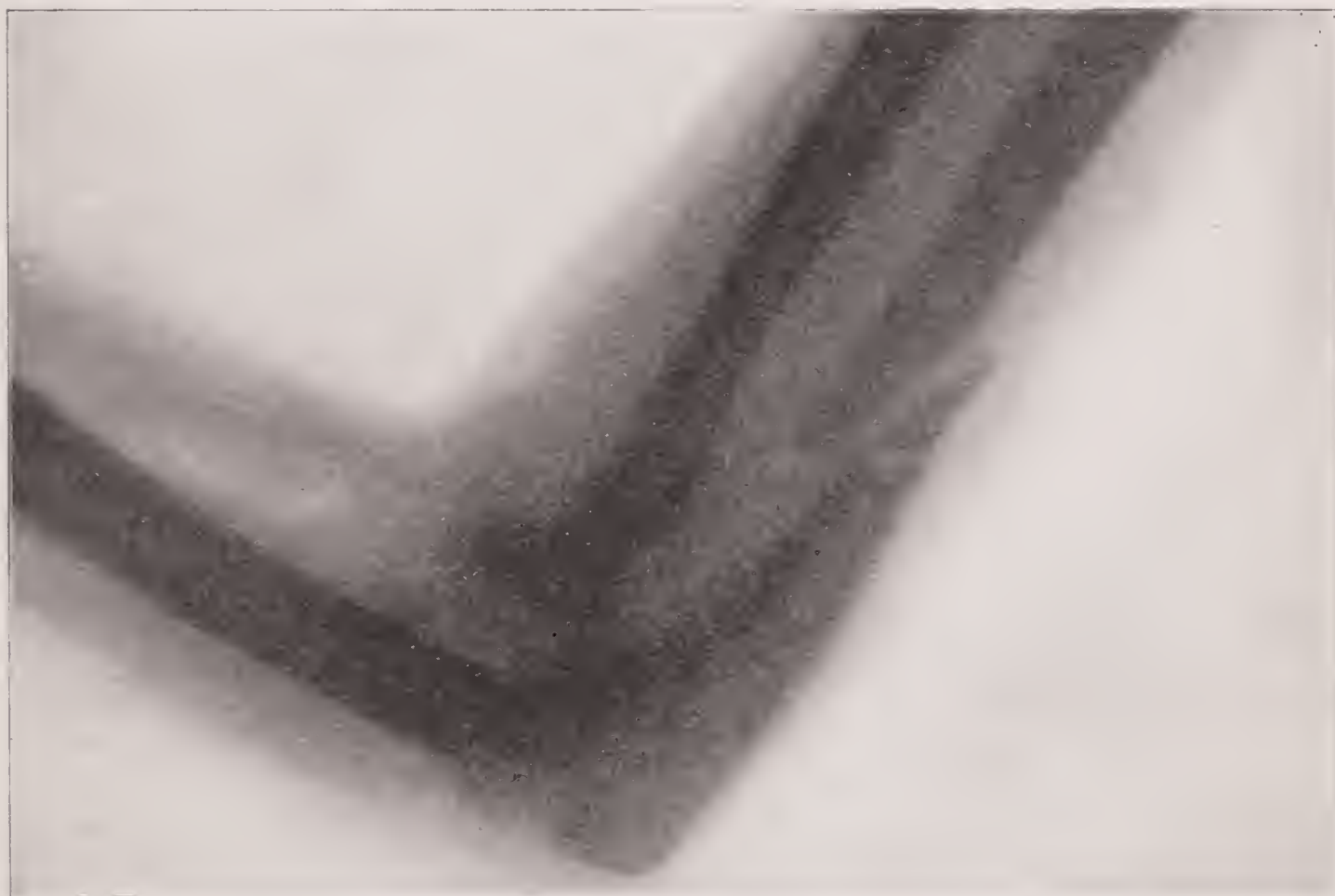
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THE ROENTGEN OR "X" RAYS

It is barely five years since the announcement was made through the press that a discovery had been made by which pictures

can be taken showing the interior of the human body. The announcement was greeted with widespread incredulity at the time, but within the five years that have elapsed, the public has become entirely familiar with the pictures and the phenomena involved in their production, and the stage of wonderment has almost passed.

The discoverer was Professor Roentgen of Wurzburg University, Germany, whose experiments, carried on through a considerable period, had reached this triumphant conclusion. The rays utilized for this purpose are developed by the Crookes tube, the invention of a famous English chemist. As the peculiar electrical rays thus generated and identified by Professor Roentgen were hitherto unknown, he used to designate them the algebraic term of X, meaning an



A ROENTGEN RAY PHOTOGRAPH OF A BROKEN ARM.

A fracture of the ulna, with dislocation of the radius.

unknown quantity. His fellow scientists throughout the world, recognizing his noteworthy contribution to science, promptly named them the Roentgen rays, and it is by this name that they are properly known, although the popular usage still applies the characterization of X rays.

Until the discovery of these rays and the application of them to practical use, it was impossible for surgeons to be absolutely sure of the location of bodily injuries or the condition they would find within the body, until after an operation. By their means, however, it is now possible for the surgeon to examine fractures or the condition of the lungs, to trace the location of a bullet, or to make such other examination of internal ailments as is necessary. It has been possible to use the rays so that a bullet lodged against a man's heart was photographed before removal and was then taken out and the recovery of the man assured. Foreign growths in the lungs, pins and needles which have penetrated into the body, broken ribs, swallowed buttons, and all such things can be examined with care prior to the operation, so that the necessary surgery can be performed with the least danger to the patient. The use of these rays is not objectionable nor painful to the patient, except when experiments are made repeatedly upon the same person, when sometimes the weakening of certain vital organs has resulted. It is a recognized discovery in surgery that is utilized in all the principal hospitals of the world as a measure of the greatest value.

Brain specialists have hailed with joy the X ray as a medium for learning whether clots of blood are pressing on certain parts of the brain, thereby causing insanity or inaction of some of the faculties.

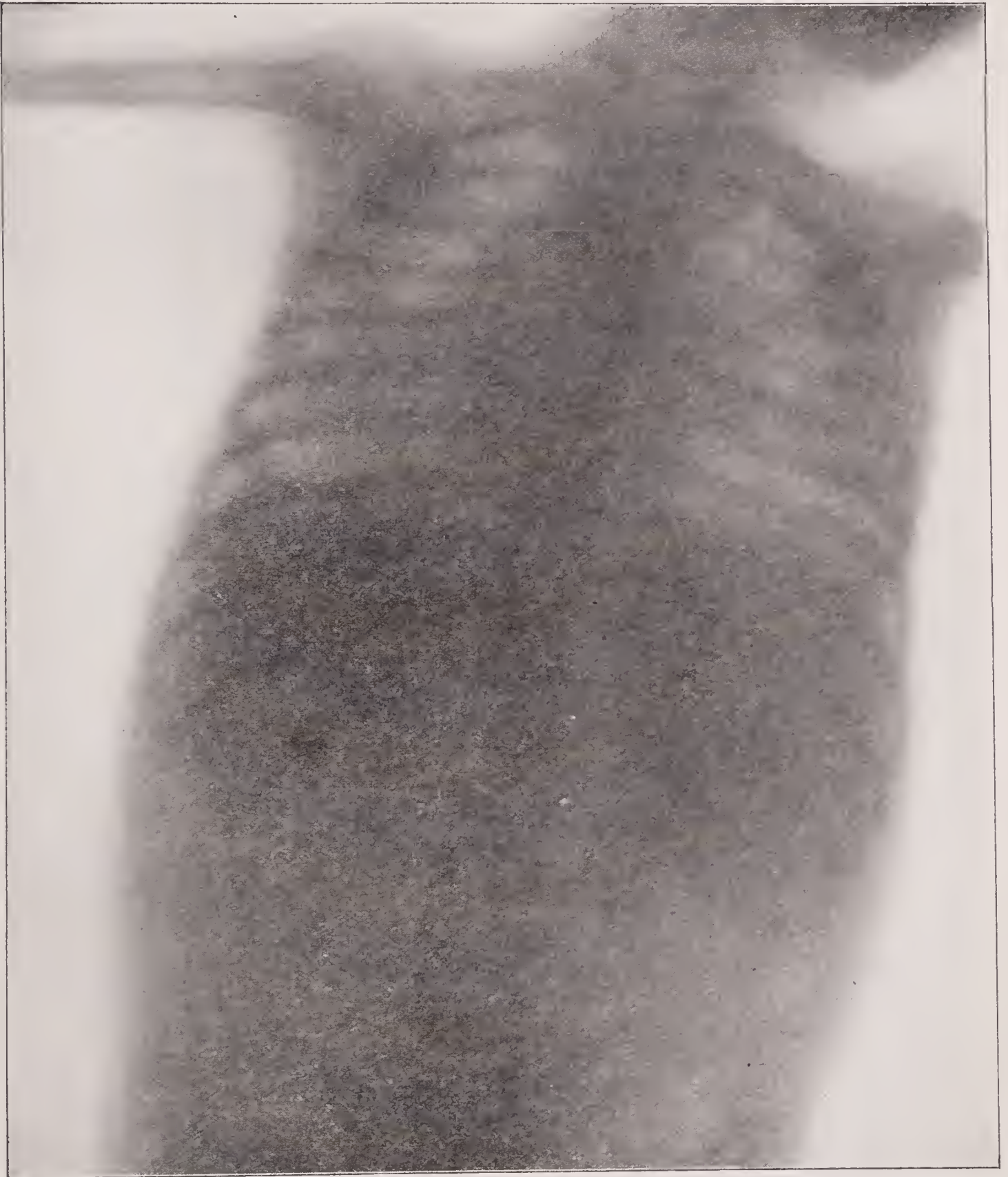
One well-known lawyer in a fight with burglars received a severe blow on the head which rendered him insane at times. By means of a skiagraph or X ray picture, a shadow was seen that indicated a pressure on one of the brain convolutions. A cleft was made in the skull, the pressure removed, small bone particles placed over the cleft and the skin replaced. Apparently the lawyer's reason was restored.

In stomach diseases it has been very difficult to locate enlargements or to indicate conditions of the membranes. Recently saturated chemical solutions impervious to the X rays have been poured into the stomach, and skiagraphs taken which resulted in remarkable discoveries. Other uses of these rays are constantly coming before the public. Some time ago a Chicagoan suffered great agony from what seemed to be an abscess behind the base of the nose. By means of the Roentgen rays a skiagraph showed that the sufferer had in the cavity at the back of his nose a small sac containing thirty-two miniature teeth. An operation was performed successfully, but for which the patient might have died. It is hinted that mental conditions are expected to be discovered by the aid of this remarkable light. Certainly nearly every other malady has been treated with a measure of success. The heart can be seen beating in one's breast, and enlargements or diseases can be promptly treated. Consumption of the lungs is discernible before it reaches its last stages, and ruptures, fractures and the presence of foreign substances can at once be noted.

Apart from medical use the X ray was recently employed to explore the interior of a mummy casket that had never been opened since the time that some old Egyp-

tian Pharaoh had been wrapped in his burial clothes. Also mummified animals, so dried up that the family to which they

belonged could not be ascertained, were easily classified after skiagraphs had been made of their bones and skulls.



HATPIN IN THE STOMACH OF A THREE-YEAR-OLD CHILD.

The hatpin shows with the head downward in the stomach. It was removed by operation. The hatpin was six and one-half inches long.

Some noteworthy experiments have been made which display the remarkable scope of the application of the Roentgen rays. Coins inside of pocketbooks, the lead in a pencil, the kernel of walnuts within the shells, and spectacles within their cases, have been photographed. Fish, mice, and frogs have been photographed, showing the skeletons.

The ordinary camera may be used in photographing by the Roentgen rays. A sensitive plate is laid in a box, face downward, over the subject to be photographed. The Crookes tube which develops the ray is placed under the table or stretcher on which the subject is resting and the light passes through the patient's body and prints a shadow picture on the plate. In the original experiments, there was great danger of burning the patient by the electrical current developed, but this has been obviated by more improved appliances. The electrical current itself is produced by the static machine and this current passes through the Crookes tube and illuminates whatever part of the body it is desired to examine.

It is apparent that the possible uses of such a discovery are manifold, and its value is impossible to be measured. With the whole human body thus subject to careful examination, it is a guard against unnecessary or misdirected surgery. Thus is one more scientific discovery added to the list of those of noteworthy importance, not merely in the limited circles of special students, but to the whole world.

There can be no monopoly in brains, and no monopoly of the benefits which come to the world from such great scientific achievements. We all share the advantages of intellectual progress, whatever its form.

MODERN DEVELOPMENTS OF ELECTRICITY

Electricity is a force of nature which is utilized in almost every department of industrial activity to-day. Its applications are so varied in the transmission of power, light and intelligence, that it is no longer possible to ignore it in the development of any great mechanical and industrial enterprise or even in the common activities of life. It is not necessary to turn to such recent applications of electricity as wireless telegraphy, Roentgen rays and the like, to be impressed by its importance.

It is the electric telegraph which trans-



Thomas Edison

mits our messages from town to town, the world over, in the twinkling of an eye. It is the telephone, perfected by careful experimentation, that enables us to communicate by ordinary conversation between persons not only within the same town, but a thousand miles apart. It is the electric trolley car which has speedily supplanted almost all other systems of street railway transportation. The European cities are following those of America in this manner, and trolley-lines are being constructed all over the world as fast as the multitude of electrical supply and manufacturing companies can produce the materials. It is within comparatively recent years that we had the first introduction of the electric light, both arc and incandescent, and yet now it is almost universally used in cities for all public purposes, and

is rapidly extending into the smaller towns. Pictures are sent by telegraph so that an artist in one city may transmit them instantly to another city, in complete reproduction.

Experiments have shown that plants may be grown under the electric light almost as successfully as under the sunlight. It is in St. Petersburg that the most important experiments in this direction have been made. Owing to the long winters in the far north, during which the daylight is brief, in conservatories it was found difficult to produce thrifty plants and flowers at this season. It was this that stimulated the experiments with electricity, and it was found that the artificial light completely supplemented the light of the sun. In addition to this, electrical currents have been used directly to stimulate plant growing with good results.



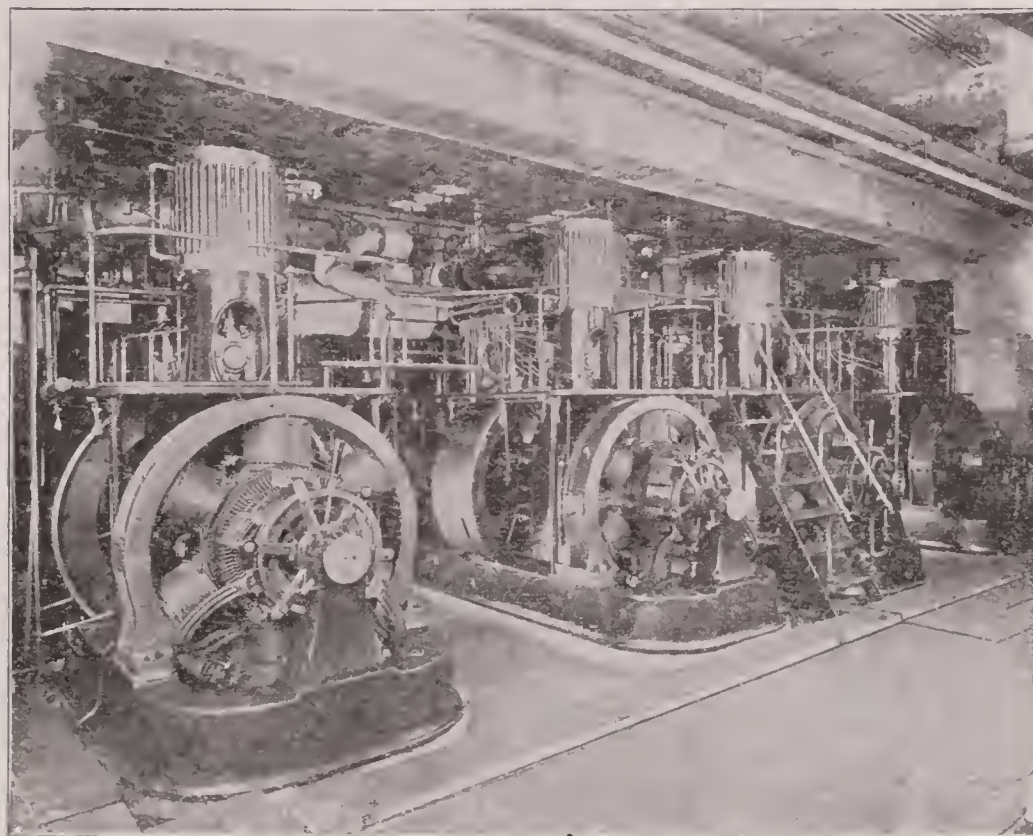
ELECTRICAL ILLUMINATION OF A CITY STREET.

In telegraphy various improvements have been made, among others being one invention by which the typewriter and the telegraph instrument are combined. The wires are attached to a sort of electrical typewriter, which, upon being operated, sets in motion a similar machine at the other end. The operator transmitting the message merely writes it by playing on the

the messages at a rate of 10,000 words an hour or even more. Such a machine makes it unnecessary to duplicate telegraph wires, by the additional speed attained. As many strips as can be prepared by a number of men can be sent over a single wire in a few minutes.

The developments of trolley lines are numerous. In addition to the well-known

street railway systems operated by overhead trolleys, there are other modifications of this method of power-transmission which have not yet come into general use. The underground trolley, favored because it obviates the necessity of using the unsightly poles and dangerous wires of the overhead system, is utilized in a number of progressive cities, and beyond question will come into more general use. The modern elevated railways of Chicago and other cities are oper-



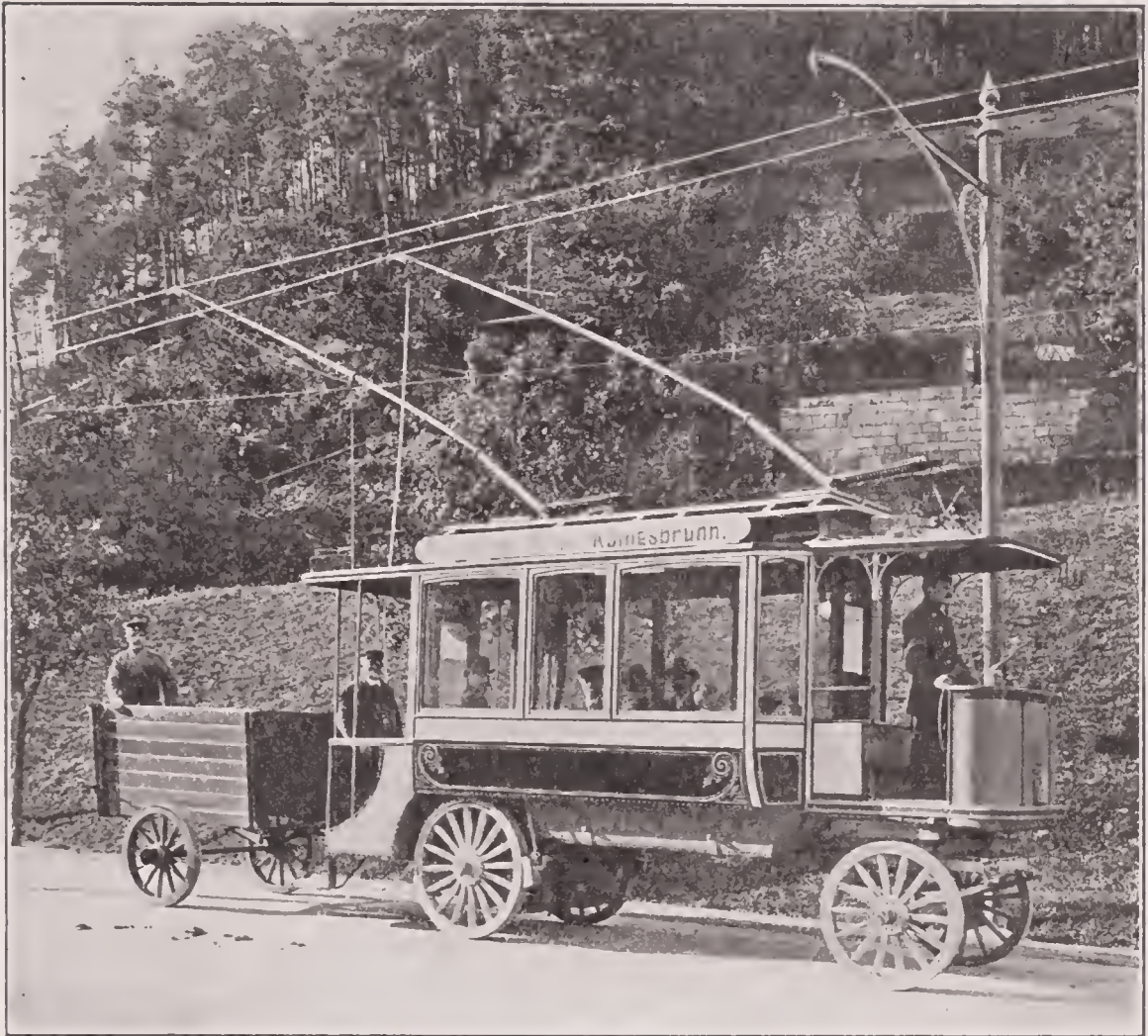
DYNAMOS OF AN ELECTRIC LIGHT PLANT.

keys of the machine before him, and it is recorded at the receiving station, wherever that may be. By perfecting this system the transmission of newspaper correspondence will be greatly facilitated, for the correspondent himself may dispatch his account of events, without the aid of a telegraph operator. Another recent invention in telegraphy is a method of perforating strips of paper with a machine similar to a typewriter, and then placing these strips in a sending device which transmits

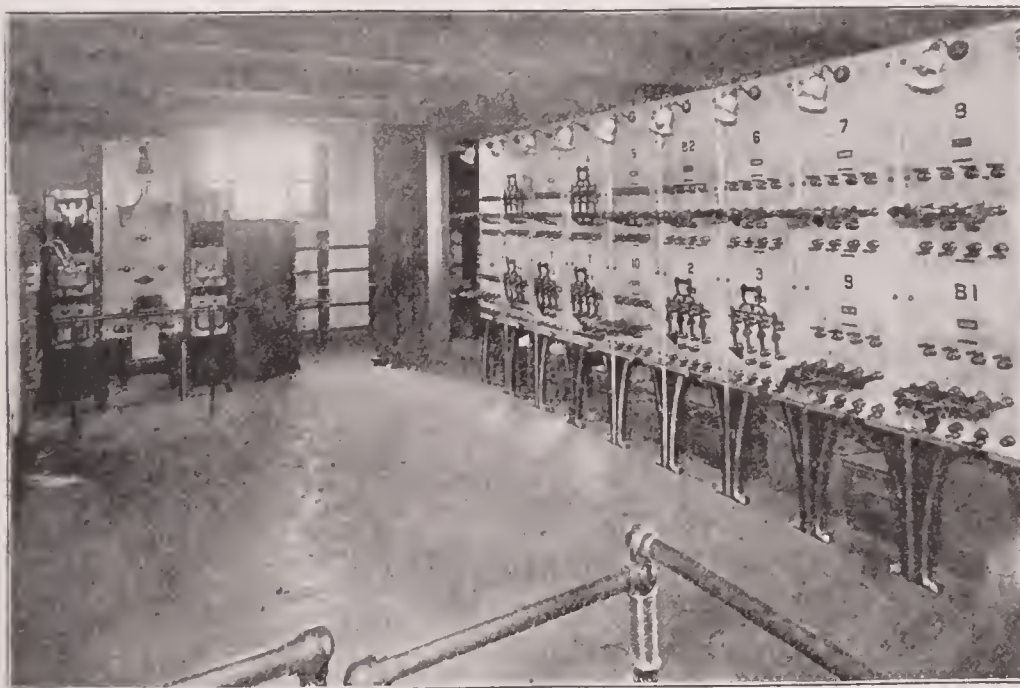
ated by what is known as the third-rail system, which is in effect a modification of the underneath trolley. The underground railways of New York, Boston, London and several European cities, which have been extending very rapidly within the last few years, are all operated by electricity and the tunnels themselves are brilliantly lighted by the same force. Canal boats are operated by trolley on several European canals, and the system is under consideration for introduction in

some American canals. Trolley cars are operated on the streets of some European cities without tracks and large quantities of freight are transported in this manner.

Electricity has a peculiar convenience of transmission from the fact that its power can be conducted for long distances over wires with comparatively slight loss. Dynamos operated by



TRACKLESS TROLLEY CAR.



SWITCH ROOM OF NIAGARA FALLS POWER HOUSE.

waterfalls and rapids have been installed in various places with great success. The most noteworthy of these undertakings is at Niagara Falls. The great cataract now generates the electric power for a large number of factories in the vicinity, for the street railways and electric lights of Buffalo, and for various other industrial purposes. The total power now developed and utilized by the works at

Niagara is about 50,000 horse-power. The flow of water over the falls is 275,000 cubic feet a second, or 500,000 tons per minute. A canal has been cut on the American side, taking water from the river above the falls, and leading it to a great pit into which it plunges, operating a series of turbine engines which connect with the dynamos. It is estimated that works could be constructed sufficient to develop 7,500,000 horse-power from the falls, so that the 50,000 horse-power now utilized may be many times multiplied. The result of this enterprise has been the rapid growth of the city of Niagara

Falls and the multiplication of large factories and industries there.

At various other cities, particularly in the west, waterfalls have been used for the development of electrical power, and many street railways and electric lighting plants are operated by currents transmitted for many miles from the source of the power.

The applications of electrical power are so numerous that they cannot even be catalogued. Great factory machinery is run by electricity; bridges are turned or hoisted by the invisible current; elevators and automobiles utilize the same power. In



A TROLLEY-CAR SNOW-PLOW ON A MONTREAL STREET RAILWAY.

fact the mere listing of the uses of electricity, industrial, scientific and otherwise, would make a chapter, as truly a chapter of wonders as this modern industrial age and its allies, science and invention, can offer.

E. E. Rines, an Indianapolis electrician, has invented an incandescent bulb by which the degrees of illumination may be varied. He has been working on it for years, and finally completed a lamp that is a success.

His invention is especially designed for dwellings, hotels and hospitals. He has taken an ordinary sixteen-candle-power globe and arranged it so that it may be turned to use eight, four, or two, candle-power. This is done by using connections that are different from the old style, and two filaments—the little wires that curve around the inside of the bulb.

By turning the globe a little the light may be reduced from sixteen to eight candle power. A little farther reduces it to four, and still farther to two. Then, if it is desired to have sixteen power again, one just turns it back and the light burns bright. The advantages of this system in a sick-room will be appreciated by the hospital authorities.

Rines is a graduate of Cooper Institute and Columbia College and worked twelve years with Thomas A. Edison.

"I have had practical as well as technical tests made of this lamp," he said. "It consumes three and one-half watts per candle power per hour, which is the same as any high-grade, high-efficiency standard lamp. When one filament is burning full eight candle-power, it consumes twenty-eight watts per hour. When burning two candle-power two filaments dark, red or in series, it consumes seven watts an hour for a night lamp. The two candle-power will save

forty-nine watts an hour. On ordinary lighting an eight candle-power lamp, which is generally used, will save twenty-eight watts an hour. When burning sixteen candle-power, the two filaments in multiple, this lamp will save over the average lamp one-fourth to two and one-half watts an hour. Its life will equal those of any three standard lamps. In consequence of current this lamp will save 13,650 watts in 500 hours, the life of an ordinary lamp."



BASKET MAKING

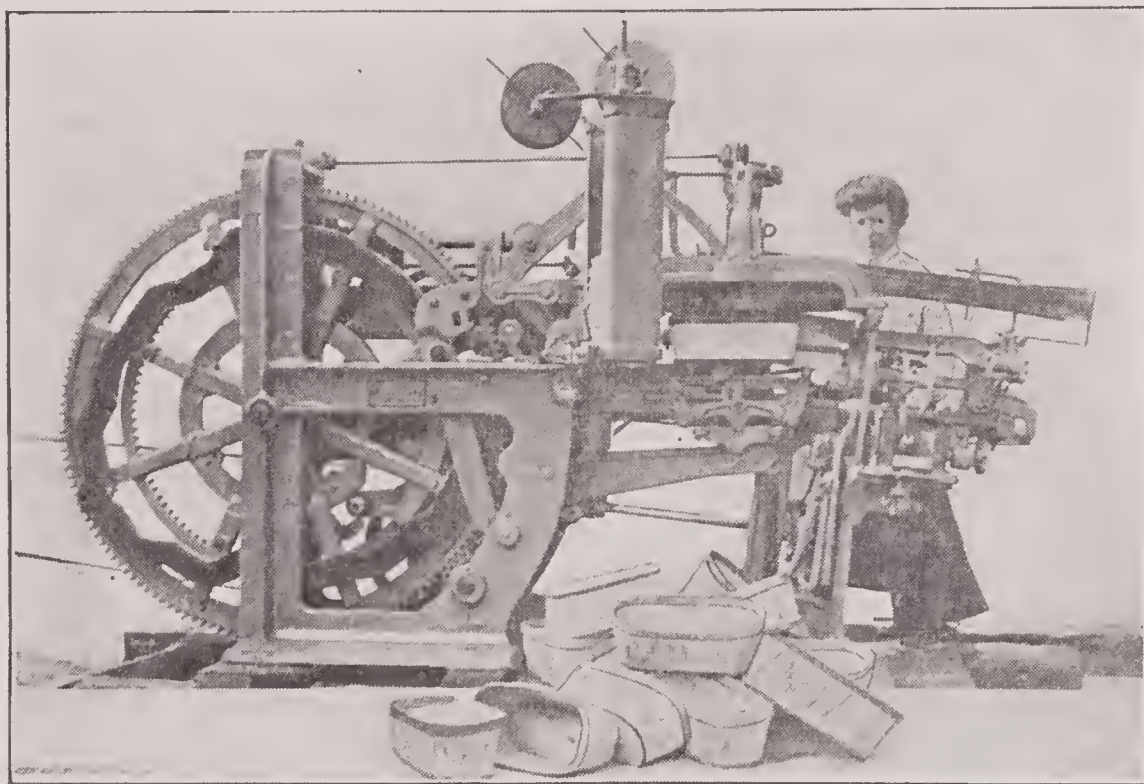
BY MACHINERY

Two billion baskets of fruit are marketed annually in the United States and the demand for such baskets is increasing at the rate of 150,000,000 per year. The peaches and the berries must be shipped into the cities with the utmost rapidity and regularity, in order to take advantage of the best market conditions, and obtain the best prices for the products. So it is that one of the most important departments in the freight service of American railways is that which gives its attention to these shipments. So it is that during the summer season, to offer a single example, the fleet of vessels plying across Lake Michigan between Chicago and the ports of the State of Michigan, are filled to the limit of their capacity with luscious cargoes of peaches and berries.

A recently perfected invention in the interest of the fruit grower is recognized as of the highest importance in this enormous traffic. These 2,000,000,000 baskets have been made by hand, and, of course, although the price has seemed low, there has been an immense waste of labor in this process. Machines have now been invented and are in practical operation, by

which these baskets are made automatically, doing away with hand work, and enabling one girl and one machine to do the work of twelve men. The names of the two inventors who have shared in this noteworthy achievement have given to the invention the name of the Mergenthaler-Horton Basket Machine. The former was already famous as the inventor of the type-setting machine, which has revolutionized the mechanical

demand of the trade. A single machine will turn out, day after day, over 4,000 complete grape baskets. A single berry basket machine will turn out 12,000 complete quart berry baskets a day or twenty baskets a minute. The machines work with almost human ingenuity, and with a precision characteristic of the mechanical exactness of the mind of a great inventor. It is difficult to give any idea of the impression this



GRAPE BASKET MACHINE IN OPERATION.

machine creates upon the mind of one who observes the work for the first time. The endless stream of baskets coming from the machine at the rate of twenty a minute, absolutely complete and perfect in every respect, with the raw material in the shape of long strips of wood

departments of newspaper offices. The new invention is considered quite as great a triumph. Hand labor in such affairs cannot hope to compete with the production of perfect machines. Already the baskets thus automatically produced have proved so successful that commission merchants urge that their shippers pack in such baskets, because they are stronger and more shapely and satisfactory.

The various patterns of machines that are made, are adapted to turn out baskets of various sizes and shapes according to the

being fed into the opposite side, cannot be satisfactorily shown by any photograph. In the three seconds necessary to turn out such a complete basket, the sides and the bottom are formed of crossed sheets of wood of appropriate shape, bent by means of a form and a die, secured at their edges by wrapped bands lying inside and outside the edges, and strongly nailed by staples cut into proper lengths from a roll of wire, bent and driven firmly into the wood. The grape baskets are made on similar principles.

LIQUID AIR.

Liquid air seems almost a contradiction in terms at first thought and yet scientists are able to liquefy not only air but many other gases, while they can also turn solids into liquid, and the resulting liquid into gases. It is all a matter of temperature and pressure. Charles E. Tripler, a scientist of New York City, is the one who made liquid air familiarly known, cheapened its production and applied it to practical commercial purposes. He was not, however, the pioneer in the experiments. Scientists had long observed that to compress a gas into a reduced volume, raised its temperature greatly. The heat thus resulting was believed to be generated by the pressure applied, but experiments soon proved it was not caused by the actual increase of heat of the whole body, but rather by the concentration of the heat of the entire mass into the smaller space.

Experiments next showed that if this gas under pressure was cooled, and then allowed to expand to its former volume, it would fall greatly in temperature, and in practice a drop of 200 degrees was readily obtained. Scientists made little headway in the effort to liquefy air, until 1877, when a French experimenter named Raoul Pictet submitted oxygen gas to a great pressure, combined with intense cold, and produced a few drops of clear liquid that soon evaporated into the air after a few moments of violent bubbling. Fifteen years later, in 1892, there was a like success with nitrogen, the other constituent of air. About the same time Professor Dewar of England performed the same experiments, and then succeeded in producing a small quantity of liquid air, or rather a sort of slush of air, water and ice. Professor De-

war's experiments aroused the utmost interest among scientists, but the cost of the apparatus and processes, which amounted to \$3,000 for this first ounce of liquid air, limited it to laboratory experimentation.

It was Professor Tripler who devised the means by which this wonderful product could be made with ease, at a cost of not more than twenty cents a gallon. His process comes as near being a practical form of the chimerical perpetual motion as can be conceived, for he utilized power generated by the liquid air itself to produce more liquid air, and as the production from a given quantity is in each instance a larger quantity, there is the constant increase of power at command. After exhaustive investigation of various ice-making and refrigerating plants, such as are used in packing houses and breweries, he devised the apparatus now in use.

A typical apparatus includes a power plant operating an air compressor, and a barrel shaped tank about fifteen feet high, penetrated by a multitude of small pipes and valves, protected by felt and canvas to keep out the heat. It is arranged so that the expanding air, which constantly grows cooler, passes about the pipes containing the working material. Air is placed under a pressure of 2,500 pounds to the square inch, and cooled to about fifty degrees by being passed in pipes through cold running water. Next it is conveyed to the receiver through two sets of pipes, one containing the air to be liquefied, the other the air that does the work of liquefying, both under the same heavy pressure. By opening a tap in the receiver, the air from the latter pipe rushes up and around all the pipes in the barrel-like space, expanding, reducing the pressure, taking up the heat wherever

any can be found, growing warmer, and gradually rising to the top of the space.

During this process it is cooled, the air confined in the pipes and now gradually returning to the compressor, is again brought under pressure and cooled, only to be released once more in the receiver to absorb more heat from the confined air in the pipes. This process is so rapid and so effective, as the temperature of the air under treatment goes down in jumps of 100 degrees every time it is treated to this chilling process, that it takes only fifteen minutes to produce the desired result. At the end of that time the faucet at the bottom may be opened, and the liquid air at a temperature of 312 degrees below zero begins to flow from the pipes.

In order to preserve the product thus yielded, various devices have been prepared. Liquid air is of such an expanding nature that if confined it would explode, so it is carried sometimes in a bulb of glass, surrounded by an outer vessel of glass, the two having a vacuum between them and joined in a common neck at the top. The vacuum delays the passage of heat, so that the evaporation of the liquid in the inner tube is reduced to a minimum. The cold, heavy mist that evaporates from the surface of the liquid and remains in the mouth of the bulb, helps to shield the rest of the contents to some extent. A similar vessel for commercial uses and the shipment of large quantities of the liquid, has been made from heavy tin, covered with felt and canvas. In a shipment of nine hours, air thus packed loses less than one-third of its bulk.

The commercial possibilities of this peculiar product are hardly yet realized, although it is clearly understood that as a

source of concentrated power it has great value. It is eleven and one-half times as powerful as compressed air, and yet it may be carried in a pasteboard box, while the heaviest steel tanks would be required to control as much energy in compressed air. Experiments are in progress in the laboratory of Mr. Tripler all the time, looking toward the applications of liquid air for motive power. Airships are seeking something that combines great power with lightness; submarine navigators want an economical motive power and air for the crews to breathe; deep sea divers hope that some service may be rendered to their perilous profession by the use of tanks of the liquid adapted to their apparatus, and automobiles have been adapted to this power. In mining, in the production of incandescent electric light bulbs, in surgery and in the production of explosives, the same peculiar substance has its manifest use.

The degree of cold which this temperature indicates is hard to realize. Mr. Tripler has appeared in public and performed many picturesque and striking experiments which indicate this. A rose may be frozen in its full form, or an egg be made so solid that when broken it will scatter like a powder. The surface of a frozen potato is as hard as stone and beautiful as ivory. Frozen butter may be pounded in a mortar until it is as fine as flour, and raw beef steak becomes pale and then breaks like petrified wood. We have generally considered mercury and alcohol as difficult to freeze, but when they meet this powerful liquid, mercury becomes hard as a rock and alcohol a white, stringy substance like molasses candy. Steel in bars may be readily reduced to flame by dipping it in a glass of this air and lighting it.

LUXFER PRISMS AS LIGHT TRANSMITTERS

While some scientists have been busy with new inventions for the production of improved light from electricity and gas, others have given their attention to the



HOW THE PRISM ACTS. Showing ray of light from above, deflected to a horizontal course as it passes through the glass.

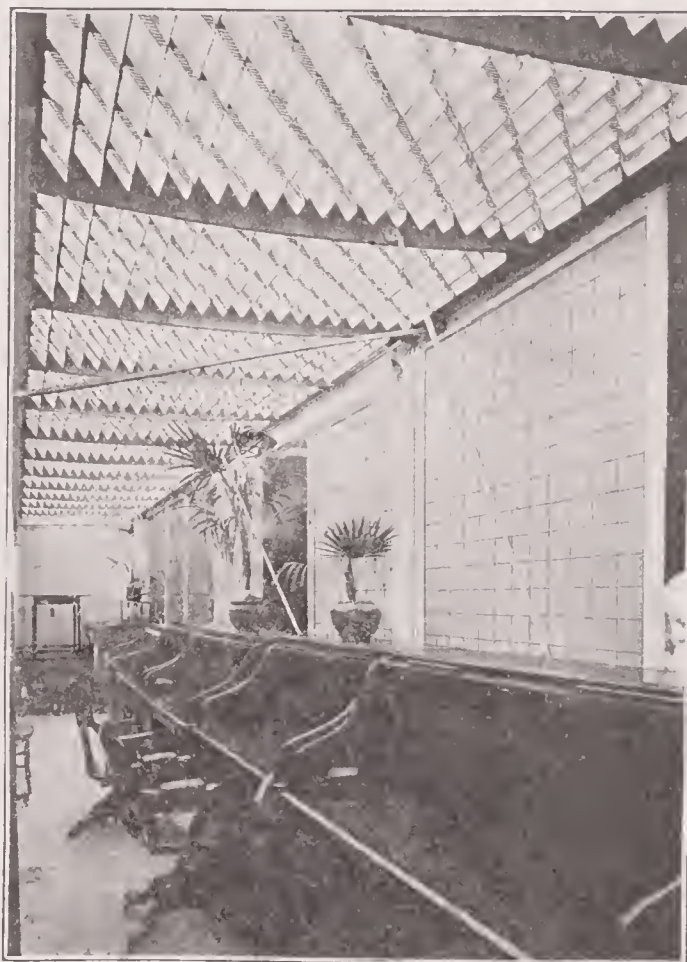
more effective use of the light which is free to all, that of the sun, which is the ultimate source of all light. The Luxfer prism, invented by a Canadian investigator of the phenomena of light, J. G.

Pennycuick, is admittedly one of the most noteworthy of contributions to practical optics.

Luxfer prisms are sheets of crystal glass having a smooth outer surface, and an inner surface divided into a series of small, accurately formed prisms. They can be united into plates of any size, to fit any window sash. The rays of light from without, that strike the smooth surface, penetrate it as they do any other glass. The prisms on the opposite surface, however, are set at such an angle that the light passing through them is refracted to a horizontal direction, and thus illuminates the room much farther from the window than is the case with ordinary, plane-surfaced glass. The dark corners are lighted, the gas and electric light bills are reduced, and all this without a meter to continually register the saving and bring in a charge for it.

These prisms and their modified forms are applied to use in a multitude of ways.

Large stores have them placed in the transom frames above the front windows, so that the rear of the long rooms may receive ample light. The same prisms placed like an awning in front of windows in a narrow, shaded street, gather the scanty light



LUXFER PRISMS IN USE. Illumination in a basement salesroom by means of prisms in the sidewalk.

from above and deflect it into the building so equipped. Sidewalks made of Luxfer prisms receive the direct light from the sky on the upper face, and turn or refract it into the basement of the building adjoining. It is said that more than five thousand prominent buildings throughout the United States installed Luxfer prisms within the first five years of their manufacture. This is noteworthy evidence of the fact that new inventions that are of genuine value are sure to find welcome.



ON THE AUDITORIUM TOWER—HOME OF THE WEATHER BUREAU IN CHICAGO.

Here, 320 feet above the ground, the observations are made which help to forecast the weather for the Great Lakes region. The small tower with the encircling balcony is the signal service office, and the instruments are on the roof.

THE WEATHER BUREAU AND ITS WORK

Before the invention of the electric telegraph for the prompt communication necessary between various parts of the world, and the numerous special instruments devised by scientists for recording atmospheric conditions, people depended upon the opinions of keen local observers, whose experience had taught them the significance of various visible signs. All sorts of traditions and predictions that had come down from the past were heeded. The origin of scientific weather study is of comparatively recent date. Even now the value of it is not fully understood. The well-founded doubts and jests based upon the superseded method of predictions still remain. People do not realize the completeness of the organization of the Weather Bureau

and the real scientific accuracy of its work. A single error in a forecast becomes more conspicuous than a score of accurate predictions, and the result is that the weather man is still not fully appreciated.

The Weather Bureau of the United States Department of Agriculture publishes daily more than 100,000 weather bulletins, not counting the forecasts in the newspapers. Most of these bulletins are in the form of postal-cards, printed by postmasters from telegraphic reports, and sent by them to outlying towns for display at suitable points. There is also an elaborate system of redistribution, by means of telephones and railroads from established centers, so

that there are comparatively few accessible places which do not now receive daily weather forecasts, even a very short time after the observers have completed their work. The old system of conveying information about the weather, by means of flag displays, is also in general use.

It is a wonderful picture of atmospheric conditions that is presented twice daily to the trained eye of the weather forecaster. It embraces an area extending from the Atlantic to the Pacific, from the north coast



MEDICINE HAT, ON THE SASKATCHEWAN RIVER.

From the great plains of the Canadian northwest come the blizzards of mid-winter.

of South America northward to the uttermost confines of Canadian habitation. America's cold waves, hot waves and storms are shown wherever present in this broad area. Their development since last reported is noted, and from the knowledge thus gained their future course and intensity is quite successfully forecast. Every twelve hours the kaleidoscope changes, and a new graphic picture of weather conditions is shown. Nowhere else in the world can meteorologists find such an opportunity to study storms and atmospheric changes.

In our Atlantic and Gulf ports there are floating over \$30,000,000 worth of craft on

any day of the year. And at every port, whether on the Atlantic, on the Pacific or on the Lakes, there is either a full meteorological observatory or a storm-warning display man, who attends to the lighting of the danger lights at night, to the display of the danger flags by day, and to the distribution of storm-warning messages among ves-

protected with greater certainty through these warnings than that of any other part of the American coast for the reason that practically all of the storms, except those from the Gulf, which reach the Atlantic coast, originate in the Mississippi Valley. The meteorological data of the Mississippi Valley storms, covering the entire period of



FORECASTING ROOM, CHICAGO STATION OF THE WEATHER BUREAU.

sel masters. While the daily predictions of rain or snow by which the public measures the value of the weather service are subject to a considerable element of error, namely, about one failure in five predictions, the marine warnings of the service have been so well made that in over six years no protracted storm has reached any point of the United States without warning being displayed well in advance. As a result of these warnings the loss of life and property has been reduced to a minimum.

The shipping of the Atlantic seaboard is

the service of the Weather Bureau, shows that these storms reach the Atlantic coast in about twenty-four hours from the beginning of the eastward movement. It is only necessary, therefore, for the weather observers to note the origin of the Mississippi Valley storm and the beginning of its eastward movement, in order to predict accurately the time of its arrival on the Atlantic coast and give warning to shipping.

It is a notable example of the utility of the American weather service, extended into the West Indies, that the great Gal-

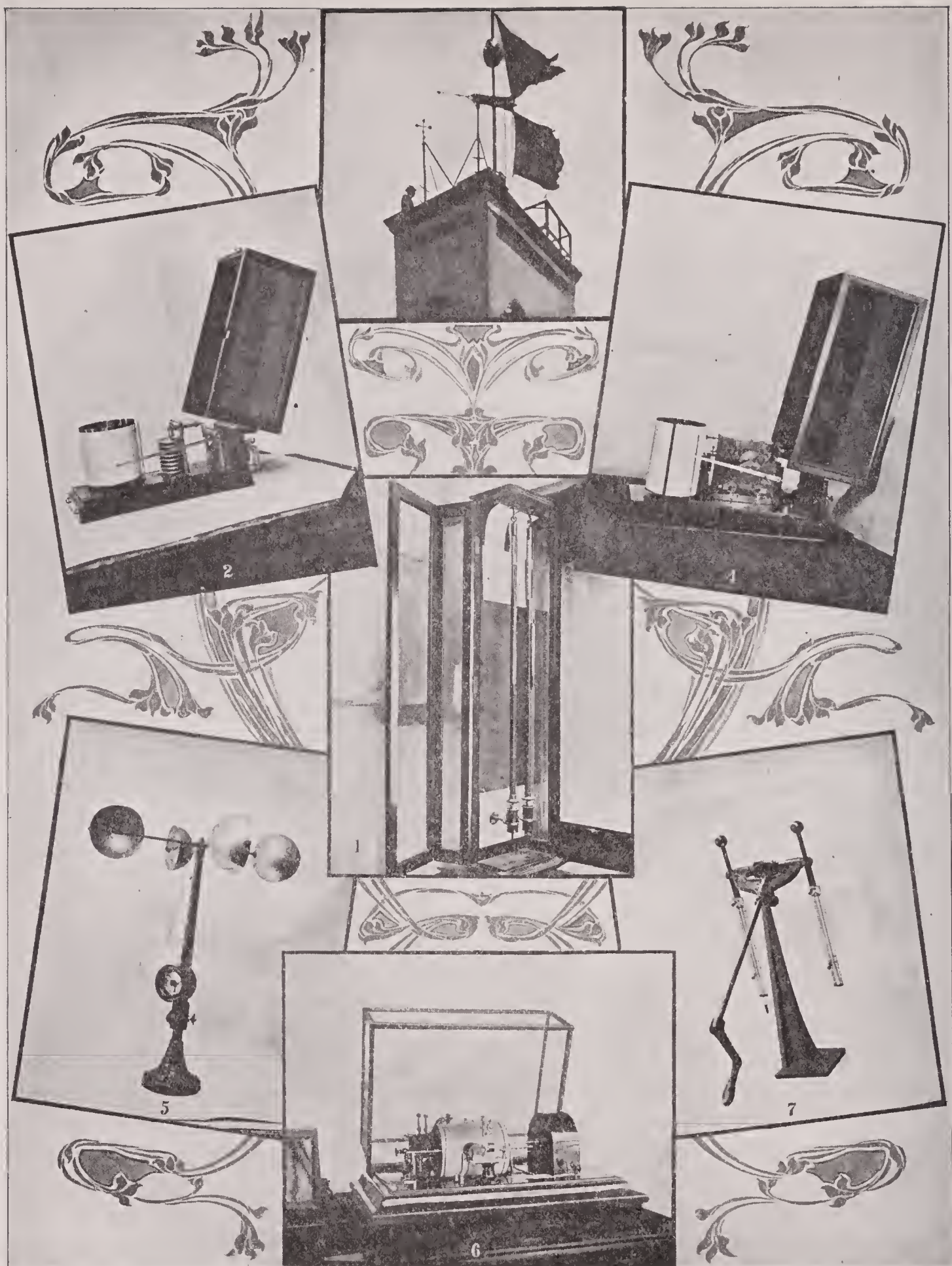
veston hurricane of 1900 was detected on September 1 at the time of its inception in the ocean south of Porto Rico, and that the reports were so complete that at no time did the observers lose track of the storm. Such full information was given as it progressed northward, that notwithstanding the extensive commerce of the Gulf of Mexico, little or no loss of life or property occurred upon the open waters of the Gulf. The destruction of life at Galveston was much less than it would have been without the warning that had been given.

When a marked cold wave develops, warnings are given so far in advance that farmers and shippers are able to save property of enormous value by protecting it from frosts. There is one instance recorded in the Weather Bureau showing from definite information that more than \$3,400,000 worth of property was saved by the advance warning in reference to a single cold wave. The fruit interests of California derive great benefit from rain warnings. On account of the peculiar topography of that region, these warnings are made with a high degree of accuracy, but a few hours before the coming of the rain, yet far enough in advance to enable the owners of vineyards, most of which are connected by telephone, to gather and stack their trays and thus save the drying raisins from destruction. In the cranberry marshes of Wisconsin the flood gates are regulated by the frost warnings of the Bureau, and where formerly a profitable crop was secured only once in several years, it is now the rare exception that damage occurs. Growers of sugar-cane in Louisiana, the truck gardeners from Virginia to the Gulf, and the orange growers of Florida, time their operations by the frost warnings of the Bureau. From the

estimates of these industries it is believed that the amount annually saved to them is far greater than that expended for the support of the entire department.

The flood warning service in operation along large rivers is another valuable feature. It is now possible to foretell three to five days in advance the height of the river at a given point within a few inches. The danger line at every city has been accurately determined, so that when a flood is likely to exceed this limit, residents of low districts and merchants having goods stored in cellars are notified to move their property out of reach of the rising waters. An illustration of the efficiency of this system was shown during the great floods of 1897. Throughout nearly the whole area that was submerged, the warning bulletins preceded the flow by several days, and the statisticians of the government estimate that \$15,000,000 worth of live stock and movable property was removed to high ground as the result of the forewarnings. Measurements of snowfall in high mountain ranges of the west have given the Bureau information by which very accurate estimates may be made as to the supplies of water from this source, to be expected during the growing season. In this way the weather service has been brought into close contact with those interested in irrigation, and has become a valuable aid to them.

The instruments used in a fully-equipped signal station of the Weather Bureau are most ingenious and perfect in their applications. The ordinary thermometer and barometer, with which most people are familiar, are but rudimentary in the processes of forecasting the weather. Nevertheless they are prime requisites. The barometer registers the changing pres-



INSTRUMENTS AND EQUIPMENT OF A WEATHER BUREAU STATION.

1. Barometer; 2. Barograph; 3. Signal tower showing flags, anemometer, anemoscope and time ball;
4. Telethermograph; 5. Anemometer; 6. Triple register; 7. Hygrometer.

sure of the atmosphere. The barograph is an improved barometer, which keeps perpetual record, automatically, of the atmospheric pressure. The telethermometer combines the functions of the thermometer and the telegraph. It registers automatically, inside the signal office, what the temperature is outside, communicating from the thermometer without by an electric current over a wire. The anemometer registers the velocity of the wind. It is a perfectly balanced windmill on a small scale, connected with a dial. The anemoscope is better known in familiar language as a weather vane, for it merely points the exact direction of the wind. The hygrometer measures the humidity of the atmosphere, and thus helps to forecast rains. Then there is a triple register of great value, which records the conditions as to wind, rain and sunshine. All such instruments are gradually being brought to a higher degree of perfection, as increased attention is being given to meteorology.

It was about one hundred years after the invention of the barometer, namely in 1747, that Benjamin Franklin divined that certain storms had a rotary motion, and that they progressed in a northeasterly direction. A hundred years later other scientists gathered data and completely established the truth of that which Franklin had dimly outlined. So it was that Americans were the pioneers in discovering the rotary and progressive character of storms, and in demonstrating the practicability of weather service. This country has always kept in the lead among practical meteorologists, largely because of its area, which renders it possible to construct such a broad picture of air conditions as is necessary in the making of the most useful forecasts.

It would require an international service in Europe to equal ours in the extent of area covered, and in practical value. Australia, with an area equal to that of the United States, and well-defined conditions, has followed our example with a highly organized, effective service.

In 1870 Congress established the Weather Bureau under the War Department, and it was administered under the direction of the military branch of the government for some eighteen years, until it was transferred to the Department of Agriculture. Under the new regime its value has multiplied many times and the expenditure of the \$1,000,000 annually which the service requires has become of slight consequence in comparison with the immense benefits it produces.



MOVING PICTURES AND HOW THEY ARE MADE

The moving-picture machine, under its various names, has become comparatively familiar since the World's Columbian Exposition at Chicago in 1893, when it was first shown in its practical form. Familiarity, however, does not decrease the wonderful qualities of the invention, which is of the utmost importance in many ways. Cinematograph, Biograph or whatever it may be called, the invention is a development of Edison's Kinetoscope, another of the array of marvelous inventions which the "wizard of Menlo Park" has given to the world.

Many familiar experiments and tricks are based upon what is known in the science of optics as persistence of vision. This is a quality by which we retain upon the retina of the eye the image of what we

have seen, for a brief period after the light has been cut off or we have shut our eyes. A rapidly whirling wheel does not conceal an object on the other side of it from our view, while the spokes of the wheel in turn are actually intervening between it and the eye. The same faculty of the eye is utilized in viewing motion pictures.

A toy invented many years ago, called the zoetrope, was the forerunner of the more important moving-picture machines. It is a cylindrical box about four inches high and eight inches in diameter, arranged to turn on a pivot in the bottom, the top being removed. On the inner circumference of the box are arranged a succession of pictures, each one in a stage of motion a little farther advanced than the one before it. Through the circumference of the box a series of slits penetrates. The observer, holding the box by the pivot and twirling it quickly, looks intently through the slits as they pass his eye in haste, and sees the figures within apparently moving forward rapidly, something after the fashion of real life, although perhaps greatly distorted.

The series of experiments which followed the zoetrope all utilized the same principle found in the most perfect machines, that is to say the rapid passing of a strip of pictures differing but slightly, behind the lens of a lantern, having a shutter which cut off the light for a short interval as a new picture was moving into place, and again opened to allow the passage of light as the picture paused an instant before the lens. Not until the modern development of instantaneous photography, the dry plate and the transparent film, could such pictures be obtained rapidly and correctly enough to produce satisfactory results.

The first utilization of photography in this form was to place a number of cameras in a row, opening and shutting the lenses automatically as the moving object passed before them. Then Edison took up the work, producing the kinetoscope, by which he took a series of photographs on long strips of film, at the rate of some thirty a second. Since that time the further experiments have been merely in the direction of improved mechanical devices for taking photographs with greater rapidity and regularity, and then producing them on the screen by improved lanterns.

Strips of celluloid, varying in length from seventy feet to 600 feet, are used for making the negatives. They are sensitized the same as are ordinary glass plates or celluloid films for cameras, and are wound upon spools. The camera mechanism is so arranged that this strip of film passes through the camera at the focal point, unwinds bit by bit, stops for a fraction of a second in front of the lens while an exposure is made, proceeds for another inch when the light is cut off, stops again at the right instant for a second photograph, and so continues indefinitely until the whole roll is exhausted. By the delicate mechanism employed 1,000 pictures may be made in a little more than a minute, and each fraction of the film stops for the fraction of the second while the shutter is open, and moves on again while the shutter remains closed.

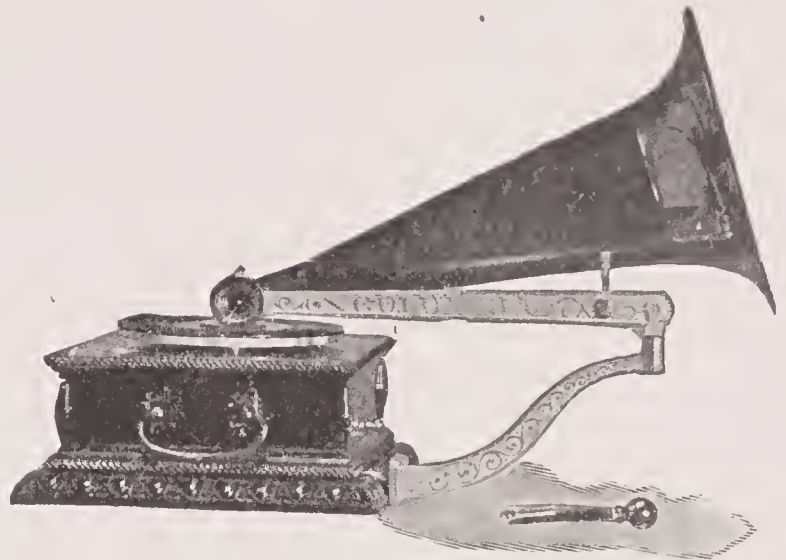
It is readily seen that to produce a series of pictures of an event extending over a considerable time, an immense quantity of films and an expensive equipment of cameras and mechanism must be provided. When the record is complete, however, the hundreds or thousands of pictures are developed, still

on the original rolls, and from the completed negatives a reverse or a positive is made upon other similar rolls of celluloid films covered with gelatine. This is in order to get all the objects into their proper relations of light, either black or white, for in the original negative of every photograph the lights and shadows are exactly reversed.

The picture is now ready to be thrown upon the screen. It is passed through a machine to which a powerful light, such as that of a magic lantern, is fitted. As the pictures pass before the lens they halt briefly, the shutter is thrown open automatically and the view is projected; then the shutter is closed, the film moves on, another picture takes the place of the first, the shutter is opened and another view becomes visible. Moving about fifteen to the second as the pictures do, the eyes' persistence of vision heretofore mentioned retains the image, and gives the impression of an actually moving object. The machines have not become so perfect as to entirely eliminate a slight jerking motion, which results from the imperfections of the mechanism, but they are continually improving. They promise to be of the utmost value in recording for the future the actual processes and facts of many important events of today. With the phonograph to preserve the voices of the great ones of mankind and the kinetoscope to portray their exact movements and manners, posterity will have a fairly complete idea of certain phases of the world as it is now. What would we not give for a series of kinetoscope pictures and phonographic records of the great events of the past centuries? History would take new forms, could such text books be utilized.

THE PHONOGRAPH AND ITS USES

The phonograph, which but a few years ago was an awe-inspiring scientific mystery, used for entertainment in exhibition halls, has been developed to a perfection which puts it in common use in great business offices and educational institutions, for a multitude of practical and familiar pur-



THE MODERN TALKING MACHINE.

poses. Talking machines under various names, be they called phonographs, gramophones, graphophones or otherwise, are all based on the same general principle. There is a metal cylinder covered with a thin layer of wax on which a pointed pen inscribes tracings corresponding to the vibrations caught by a membrane placed on top of the instrument. The wax cylinder is rapidly revolved by means of an electric battery, and as one speaks in front of the membrane the cylinder advances slowly in a horizontal position, at the same time revolving steadily. The membrane vibrates much or little, according to the sounds produced by the operator. The pen moves according to the vibrations, and peculiar, almost impercep-

tible, tracings on the wax are the result. A funnel and tube, into which the operator speaks, carry the sound to the membrane.

To obtain reproductions of the sounds as inscribed on the wax cylinder it is replaced in its original position. Another pen of different construction is mounted so that its point retraces the original tracings of the first pen, the membrane is made to vibrate again, and the sound is reproduced through the tube and funnel.

The phonograph is both the ear and the voice. It is a tympanum like the tympanum of the ear, and it vibrates in unison with the sound waves that push against it, but it does more than the ear's tympanum, for it makes a permanent record of what it hears. Like the voice, the phonograph sets in motion waves of sound, but it is not limited, as the voice, to the production of a comparatively few sound waves. Instead, every musical tone or sound of nature, single or complicated, from the delicate whisper to the crashing melody of a great military band, can be recreated.

For purposes of entertainment the phonograph in its various forms has become common, and its cost is but little. The best music, vocal or instrumental; great sermons, orations and lectures, and the dramatic readings of lecturers and elocutionists may be sent the world over, recorded on simple wax cylinders, at small expense, to be reproduced at will or to be preserved until those who spoke or sang have long since passed away.

For business purposes the phonograph is used as a partial substitute for stenographers and secretaries. Business men dictate their letters to the silent machine, which afterwards dictates them in turn to typewriters for transcription. Schools of

language have adopted phonographs for the teaching of the foreign tongues. Skilled professors dictate lessons in French, Spanish, German or Italian, and the little wax cylinders repeat them as many times as necessary to the students, thus assuring careful instruction in pronunciation. Other uses of the ingenious instrument are constantly suggesting themselves, and it is now recognized as one of the more important recent contributions of science to the world of practical inventions and utilities.



COMPRESSED AIR AND PNEUMATIC TUBES

The power of compressed air has been utilized for a long time in certain mechanical processes, but by the introduction of pneumatic tube systems the uses of it have been many times multiplied. Air compressed into a smaller space than it naturally demands tends to expand like any other compressed gas. This tendency to expansion, properly directed and controlled, becomes available for a multitude of uses. Inexhaustible as the material is, and transmitting its expansive force for long distances without perceptible decrease by friction, it is easily controlled and in reach the world over.

Among its other simple applications compressed air is used for cleaning dust out of carpets and upholstery. It may be used also for applying paint to high ceilings by means of a spray. Ground glass and glass signs are engraved in whatever patterns desired, by the force of a blast driven by a stream of compressed air. In art it is used for the finishing of crayon portraits, by means of an apparatus called the air brush.

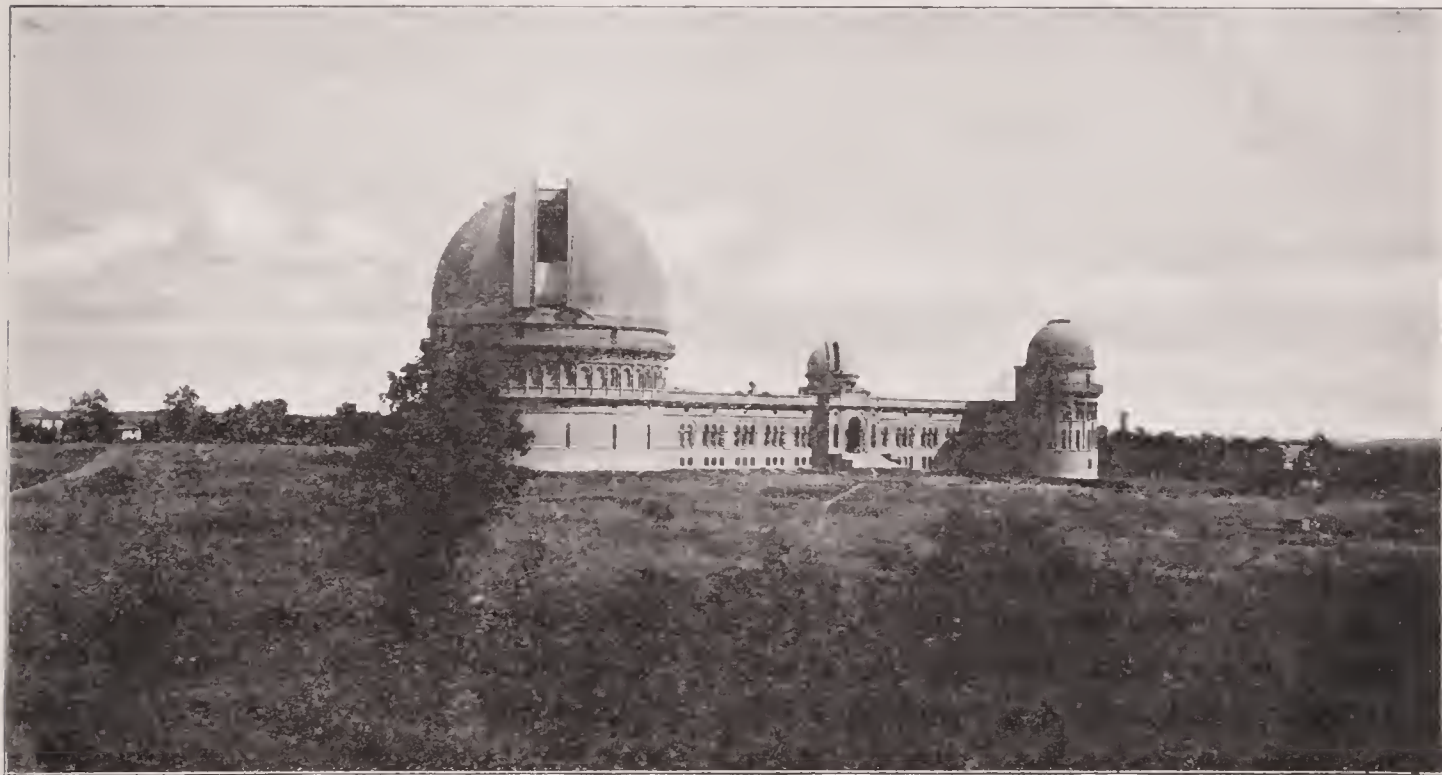
The more important commercial uses to which this natural force is applied are in the transportation of packages and the application of power. Street cars, elevators and automobiles are run by compressed air and it proves to be a safe, convenient, economical and noiseless method of power transmission. The first utilization of compressed air for transporting packages was in the great stores of New York, Chicago and other cities. Pneumatic tubes extending all over these places communicate from floor to floor, and through them little boxes are sent rapidly to the cashier's desk, conveying the money received in payment and returning the change.

From this beginning pneumatic tube systems have been developed in many other places and for more pretentious purposes. In both the cities named, and several others, such systems of tubes buried under the streets convey messages rapidly between newspaper offices and the press associations which supply them with much of their ma-

terial. An eight-inch tube extending from the New York City postoffice to the postoffice of Brooklyn, over the Brooklyn Bridge, carries many wagon loads of parcels daily, much more rapidly and cheaper than could be done in any other way.

These practical applications have proved the value of such a service, and there is a manifest movement toward the introduction of larger systems wherever traffic demands. Chicago, Philadelphia and New York moved first in the matter, inducing the national government to establish general systems between all the postoffices and branches throughout those cities. A corporation obtained a franchise in Chicago, and built tunnels throughout the business portion of the city, where all the necessary pneumatic tubes for any service demanded could be readily installed, in addition to the telegraph and telephone wires already in service.

The tubes used for these purposes are made of heavy seamless brass, highly pol-



THE YERKES OBSERVATORY, WILLIAMS BAY, LAKE GENEVA, WISCONSIN.

ished inside, and of uniform diameter. The boxes or "earriers" which travel in them are eylindrieal, to fit the tube. A strip of sheepskin bound around the box at either end, with the wool outside, makes it tight enough to be carried forward by the force of the eurrent of air, without produeing enough friction to bind it in the tube. Light carriers operated with tubes at high pressure travel at the rate of about a mile in three minutes, while heavier earriers are driven a little less rapidly. The systems are somewhat expensive to install, if large tubes are to be buried under ground, but after installation their operation is comparatively inexpensive. It has even been suggested that small passenger ears could be driven through tunnels in the same manner, but no experiments in this direetion have been made. For mail and express packages, however, eompressed air and pneumatic tubes offer transportation facilities unsurpassed, and the uses of them are growing with the utmost rapidity.



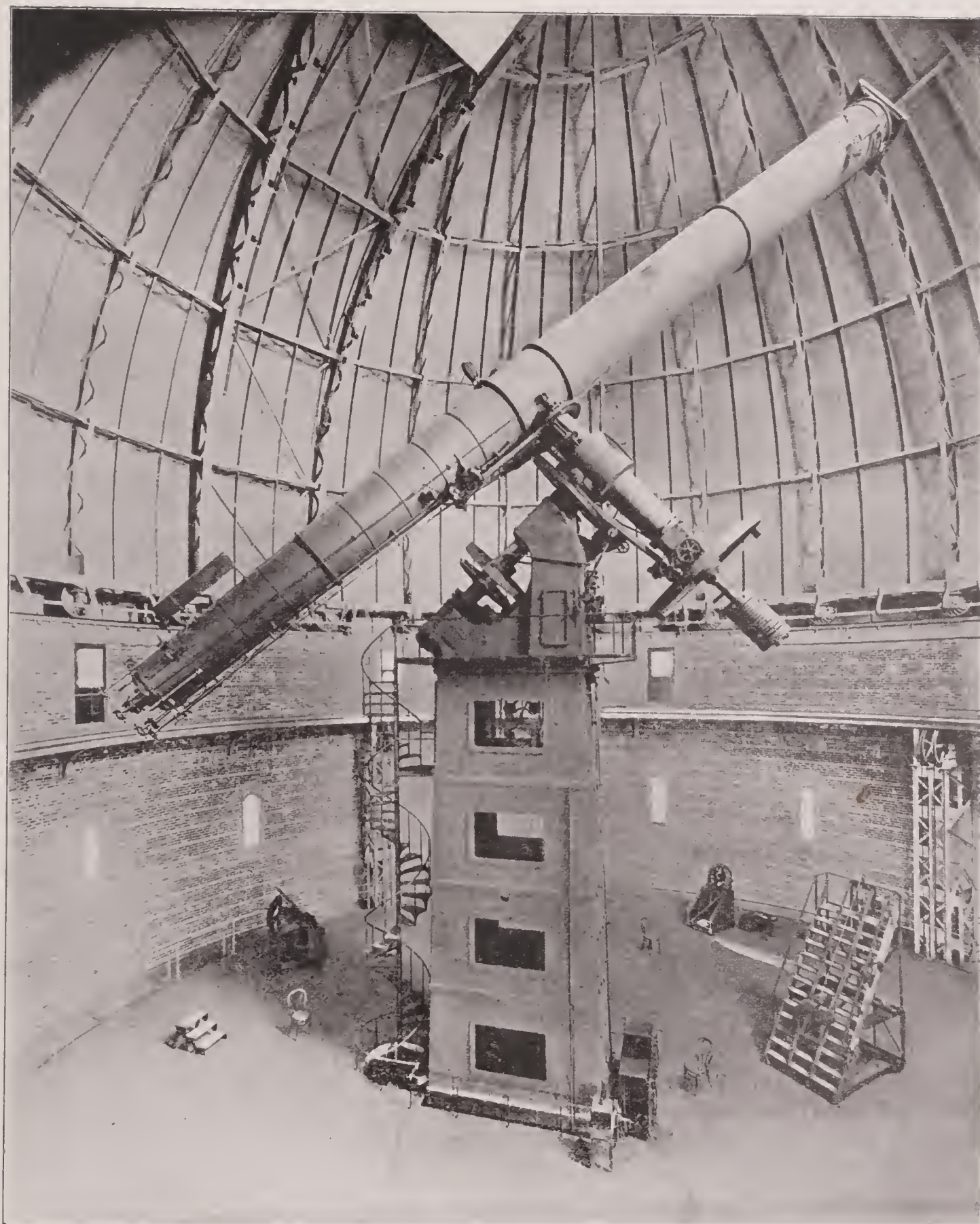
GREAT AND FAMOUS TELESCOPES

While inventors and seientists in one direetion have been improving methods of transportation and eommunieation on the earth by means of railways, telegraphs and kindred applianees others equally energetic have devoted themselves to the effort to eommunicate with other worlds than this, or at least to study them to better advantage. Telesopes have multiplied and have grown greater and more perfect, as truly as loeomotives have done, and they bring the stars nearer to the vision of the observer with striking brillianey. The United

States not only possesses the largest telescope in the world but the second, fourth, fifth and eighth as well, in the first eight.

This largest of all star-gazing apparatus is located on the shores of Lake Geneva, near Williams Bay, Wiseonsin. The great telescope and the observatory in which it is mounted were given to the University of Chieago by Charles T. Yerkes, the street railway magnate of Chicago and London. The huge lens of the great instrument has an aperture of forty inches, which is four inches greater than that of the Liek Observatory in California, its nearest rival. The lenses were ground in Cambridge, Massachusetts, by Alvan Clark, whose father was a telescope maker, and whose sons eontinue the business. The glass proper is eomposed of two lenses, one of ground glass and the other of flint glass, ranging in thiekness from three-quarters of an ine to two ine, and plaeced eight ine apart. They weigh 500 pounds and were four years in polishing, the final touehes being given by the maker's finger tips.

The great tube is sixty-five feet long and weighs 40,000 pounds, yet the whole instrument is so evenly poised that it can be moved by the hand to any angle or position. The dome of the observatory is 90 feet in diameter. Under the telescope is a floor which may be raised and lowered by means of eleetrie motors to whatever height would be most convenient for the observer. The great dome itself is likewise movable, being mounted on ear wheels which run on a track around the wall, as is elearly shown in the aeompanying illustration. At the will of the operator the whole dome may be revolved above, so that the large opening in the roof may be brought opposite any star. The motive power for the dome is elec-



THE LARGEST AND MOST POWERFUL TELESCOPE IN THE WORLD.

Interior view of the Yerkes Observatory. The tube of the telescope is sixty-five feet long and the lens is forty inches in diameter. The floor is hoisted, the telescope shifted, and the dome turned by electric motors.

tricity, and the great sliding shutters in the roof are also opened and closed by power from the dynamos. Inside the base of the tube is a clock-like arrangement that adjusts various parts of the workings, keeping the lens moving steadily in the path of the star which is being studied. The total cost of the huge telescope and the observatory was \$500,000, but the scientific results obtained have justified the cost.

As an accessory to this great instrument the astronomers of the Yerkes Observatory have built a still larger telescope of another kind. It has no great dome over it, no tube containing great lenses, and nothing to suggest its purpose to the stranger. In appearance it is merely a long wooden shed, about eight feet wide and about the same height, with a gable roof, built flat upon the ground and extending to a length of 165 feet. It is open at one end, and it suggests nothing as much as a long corn-crib or chicken-house without doors or windows. A thirty-inch mirror, mounted at the open end of this peculiar horizontal telescope, reflects the stars' rays into the long horizontal tube, to a concave mirror at the other end, which will focus the rays either upon a photographic plate or into the slit of the spectro-scope.

With this instrument photographs of eclipses, stars and other astronomical subjects can be made with great success. It is no longer sufficient to watch the stars through a revolving telescope. The apparatus adapted for the various purposes of astronomy takes widely different forms, and the most complete observatory is the one most fully equipped. It is believed that the horizontal telescope at the Yerkes Observatory is but the forerunner of another many times as large. Already one a thousand feet

in length is contemplated. The forty-inch telescope mounted in the dome gives a photograph of the moon seven inches in diameter. The completed horizontal telescope makes the moon appear more than nineteen inches across. Through the 1,000-foot telescope the observer will behold a moon 109 inches in diameter. Every little detail will be enlarged and the 8 by 10 plates now used to cover the whole image will then be used to obtain a picture of a single crater or some dark valley of the moon. With such keen scrutiny turned upon the heavens we may expect noteworthy discoveries in astronomy before many more years have passed.



SIZE OF GREATEST TELESCOPES IN THE WORLD

Name.	Place.	Inches aperture.
Yerkes Observatory,	William's Bay, Wis.....	40
Lick Observatory,	Mt. Hamilton, Cal.....	36
Imperial Observatory,	Pulkova, Russia.....	30
Naval Observatory,	Washington, D. C.....	26
University of Virginia,	Charlottesville, Va.....	26
University of Vienna,	Vienna, Austria.....	26
Greenwich Observatory,	Greenwich, England.....	26
Halsted Observatory,	Princeton, N. J.....	23

The list of those from 18 to 6 inches aperture is too numerous to tabulate.



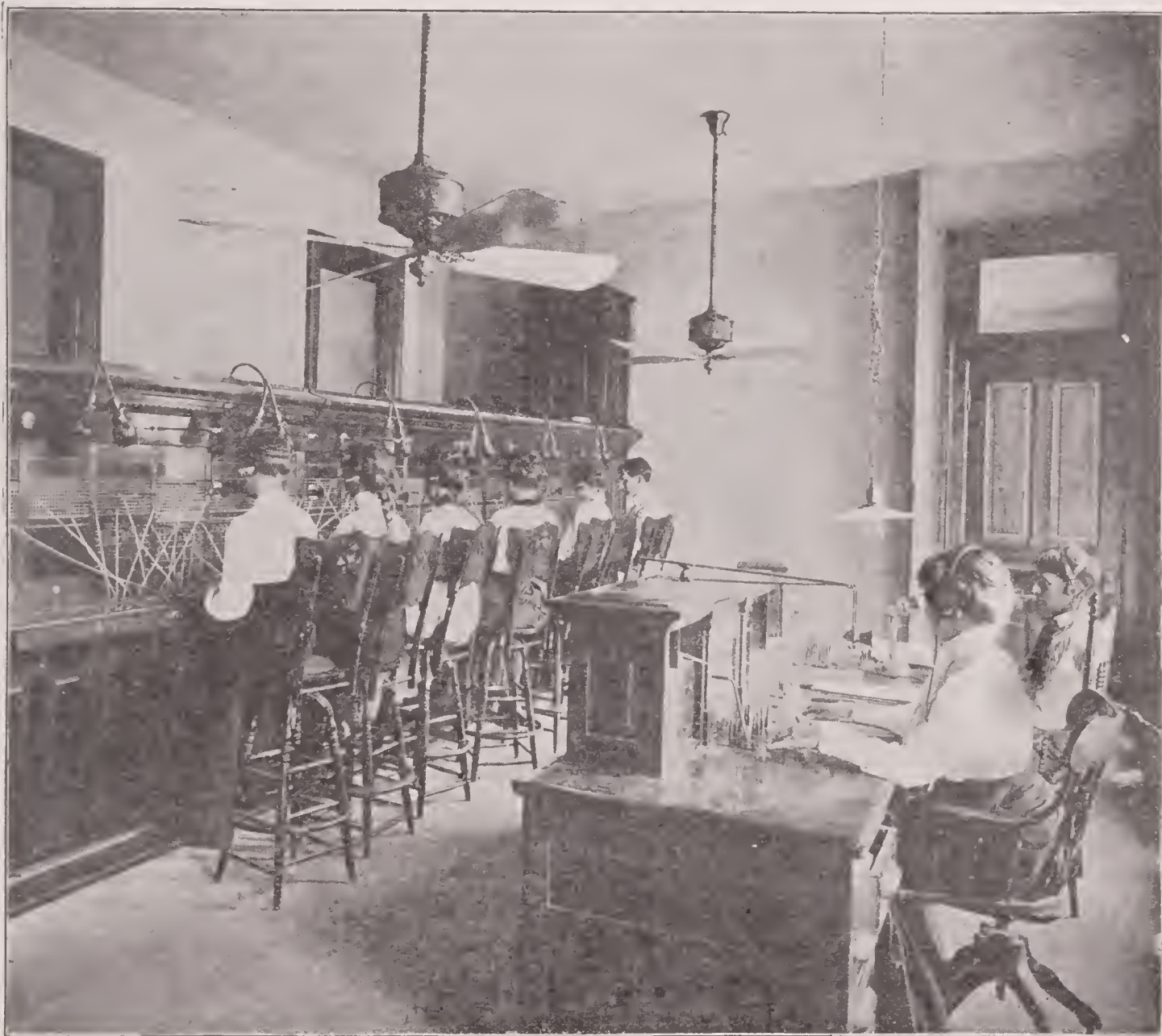
TELEPHONES, THEIR MECHAN- ISM AND DEVELOPMENT

The telephone itself has become exceedingly common within comparatively few years since its invention, but the improvements and applications of it which are made from time to time continually prove anew the remarkable value of the invention in its everyday uses.

The principles of the telephone are not extremely complicated, in comparison with those of other electrical appliances. It is well understood that when a person talks,

sings or whistles, he produces sound waves which are carried through the air, for the particles of air are thrown into vibration which is carried along from one particle to another. Similar sound waves or vibrations are transmitted through solid bodies

seasoned wood, to a surprising degree. Many experiments have been made in the transmission of sound by electricity and vibrations in solid bodies, but it was not until 1876, our American Centennial year, that Professor Alexander Graham Bell



PART OF OPERATING ROOM IN A TELEPHONE EXCHANGE.

The portion of the modern lampline multiple switchboard here shown requires six miles of silk and cotton insulated cables to connect it with the distributing racks.

when sound is made adjacent to them. It has been found that all sorts of substances which are capable of being vibrated transmit sounds, some with poor success, and others, such as iron, steel, silver and well

produced the speaking telephone which in its improved shape is the telephone used almost exclusively to-day.

A thin, flat, circular piece of iron called the diaphragm is the essential factor in the

transmission of sound through the telephone, while a similar diaphragm in the receiver at the other end of the line conveys the sound to the ear of the listener. When the voice is directed into the transmitter of the telephone, the diaphragm shakes or vibrates, because the voice makes sound-waves which strike it and set it in motion. Now the diaphragm is so sensitive to these sound waves that it moves back and forth faster or slower according to the length of their vibrations. These movements of the diaphragm in the transmitter cause different kinds of currents of electricity, supplied by a battery in the instrument, to flow over the wire to the diaphragm in the receiver. This latter one then vibrates exactly as the first one does, and sets in motion sound waves exactly like those made by the voice in the transmitter. Thus it is that one may be heard to speak at a great distance through the telephone.

Magnetism and electricity work together in the telephone. If some wire be wound around a piece of soft iron and a current of electricity be sent through the wire, the iron at once becomes a magnet and will remain a magnet just as long as the electricity is flowing through the wire. The instant the current is shut off, the iron ceases to be a magnet and becomes only a piece of iron again. A magnet made in this way is called an electro-magnet and the two forces of magnetism and electricity are very closely related. If a piece of steel, however, be magnetized, it becomes a permanent magnet. In the receiver of the telephone, in the part which one holds to the ear for hearing, is a permanent magnet made of four strips of steel, each of which is magnetized separately. At one end of this bar magnet is an electro-magnet,

with fine copper wire wound on a spool around the iron core or center which is attached to the steel magnet. Two small copper wires lead back from the electro-magnet to the closed end of the receiver, where they connect with the green covered cords which contain the wires leading through the instrument on the wall to the wires which reach the outer world.

At the open end of the receiver appears a diaphragm fitted so closely to the iron core of the electro-magnet as almost to touch it. In the transmitter there is a diaphragm, but no magnet. Instead of the magnet is a little platinum knob on the end of a slender spring which rests in the center of the diaphragm, and which in turn presses against a carbon button on the end of another spring. The wires from the platinum and carbon run to a little cylinder of coiled wire called the induction coil. The transmitter is an electric instrument, and in that respect is widely different from the receiver, which is a magnetic instrument. It so happens that an electric telephone is best for the speaking end, and a magnetic telephone is best for the hearing end.

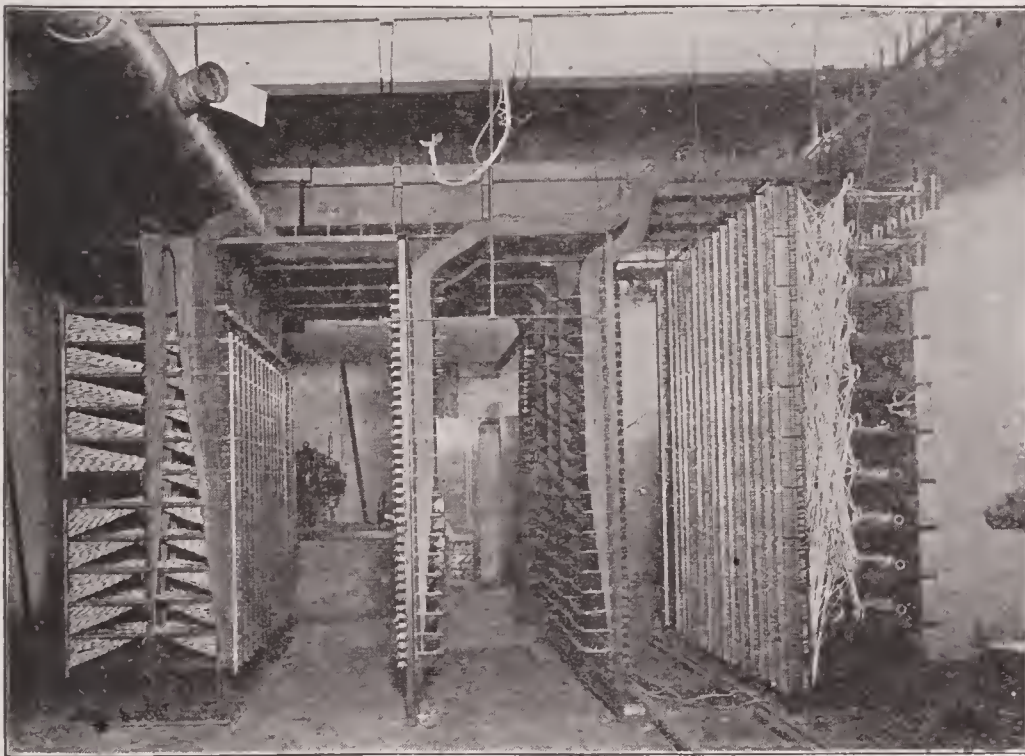
There are many more scientific details that might be explained, but the foregoing facts are the essentials in connection with the simplest form of telephones. In usage the telephone is becoming more essential every day. At first its limit was the transmission of speech for a very few miles, but now distance seems to be no barrier. Long distance telephone service is now maintained without difficulty throughout all the states east of the Rocky Mountains, and one may talk to his friend in direct conversation between places as widely separated as Montgomery, Alabama; Hastings,

Nebraska; Bangor, Maine, and Richmond, Virginia, with all intervening cities of prominence accessible by connecting lines.

And still in the United States we are behind some other countries in the quality and cost of our telephone service. The Swedish instruments excel ours in the distinctness and ease with which they transmit the human voice. They are used in many countries, and wherever they are used are highly favored. With them persons

is that telephones are found everywhere. It is an interesting feature of the telephone system in Australia that it has been extended to remote sheep stations, many miles from the cities and towns, and the telephone wires are strung along fence posts between two of the barb wire strands, thus obviating the necessity of erecting poles.

In France a system of military telephones has been developed. A part of each signal corps in the army has been organized into a telephone squad, and each soldier in the squad carries a whole telephonic outfit on his back. In the company service there are four telephone operators, in charge of a corporal, who is the "hello girl" and the "central station" combined. A telephone station is built on the back of each operator and is carried from point to point as if it were a knapsack. In his hand the operator carries a reel of wire holding enough wire, which is made with a steel



PART OF DISTRIBUTING RACKS IN REAR OF SWITCHBOARD.

The equipment here shown is sufficient for 3,500 instruments. It includes 3,500 lightning arrestors and 60,000 feet of "jumper wire."

conversing are not required to listen intently with the receiver at the ear, nor yet to speak directly into the transmitter, but they carry on their conversation with perfect ease, although clear across the room from the telephone itself. In the Australian colonies the telephone is a part of the post-office department, and there is a fixed charge of \$18 a year for the service instead of prices ranging from \$50 to \$200 a year as in the United States. One result of this

core surrounded by copper, to run a line of over 6,000 feet. The reel is connected with a sword bayonet, so that the operator by sticking his bayonet into the earth turns it into a ground-wire, for but a single wire is used, the return being an earth circuit.

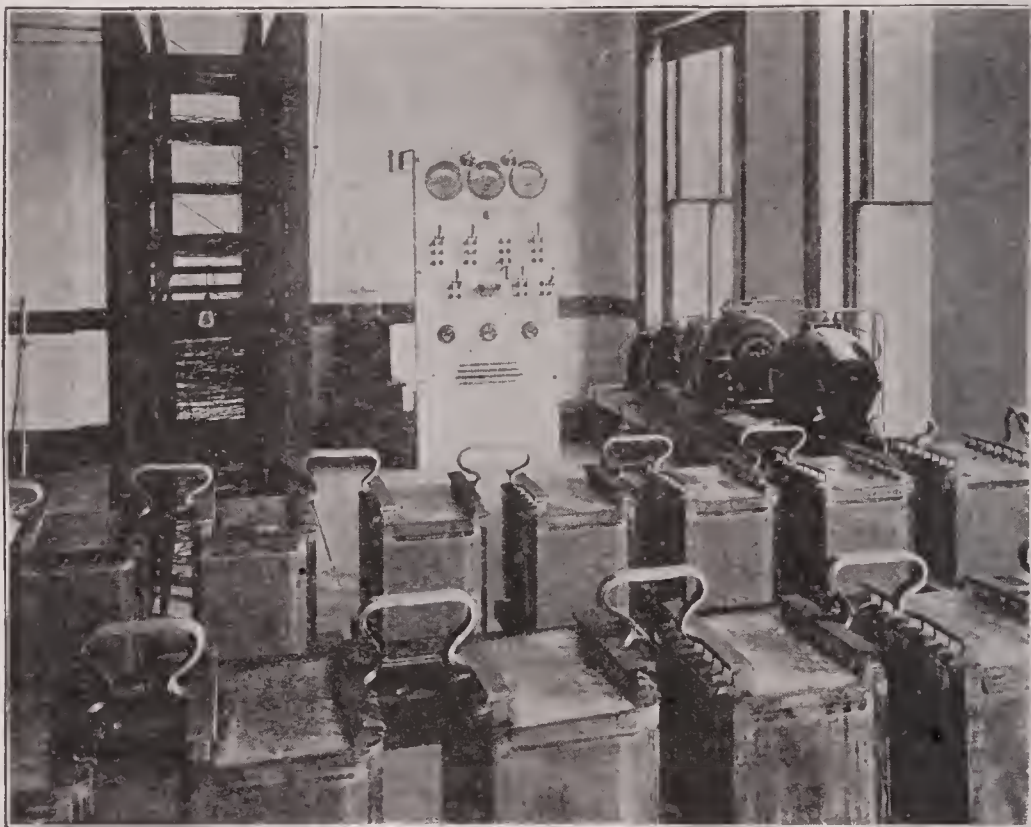
Small dry batteries are used. In establishing a regimental telephone line, the corporal takes up his station near the headquarters of the commanding officer, and fixing his telephone to his ear, sticks his

sword bayonet in the earth and orders the operators to run a line. One of them connects his reel of wire to the telephone on the corporal's back, and starts off in the given direction upon the run, the wire un-reeling as he moves forward. He keeps his line of travel as straight as possible, but selects points where the wire can be caught up from the ground on bushes and trees.

Having run out his line of about 6,000 feet, the operator makes the ground connection with his bayonet and calls up central. If all is right, operator number two connects his wire with the line already installed, and runs away until he has unreeled his wire, when he calls up central and operator number three takes up the run, which is finished by operator number four, so that a telephone line of over four and one-half miles is quickly strung by the pedestrian telephonestations. This may be one continuous line, or the four lines may radiate in as many directions from the central station.

A helper follows the line man and loops up the wire where it is possible on trees and bushes, but where there are none he leaves it on the ground. He also acts as repairer and line man moving back and forth between the stations. The operators have the receivers of the telephone strapped to their ears and thus are ready at all times

to receive orders and transmit them. The operators are provided with small camp stools, for sometimes they are stationed in one place for several hours. In such cases the telephone outfit is taken from the back, and leaned up against a stone or tree. At headquarters, during maneuvers, experimental campaigns and sham battles, stationary exchanges are installed with connections made with all parts of the field. In this headquarters central station a small



CORNER IN TELEPHONE EXCHANGE BATTERY ROOM.
Showing power dynamos for connecting with 2,500 subscribers.

switchboard is used, and the corporal, who is chief operator, receives reports and transmits the orders as readily as if wires were strung on solid poles instead of trailing through the grass over the ground. Cavalrymen are used in this service as well as infantrymen. The ground connection is made through the bit, body and shoes of the horse, while in other respects the operator is equipped with the infantry outfit.

This branch of the service is distinct from the telegraph service, which strings wires or hangs them on the boughs of trees.



TELEPHONING WITHOUT WIRES

We have had the telephone for more than a quarter of a century in practical working use, and have begun to think of it no longer as extraordinary. In truth, however, the advances and improvements in the ordinary telephone since the first successful experiments were made, mark almost as great progress as did the original invention itself. Of very recent success are the experiments of Marconi with wireless telegraphy, an astounding and important advance over the ordinary system of telegraphy through wires. Now comes the announcement that an American inventor, unheralded and modest, has carried out successful experiments in telephoning and is able to transmit speech for great distances without wires.

The inventor is Nathan Stubblefield. The first public test of telephoning without wires was made at the Kentucky village where the inventor lived, on the first day of January, 1902, only a few weeks after Marconi's success in signaling across the Atlantic by telegraph without wires.

The next demonstration was made ten days later for a newspaper correspondent from St. Louis and the account of it was published in detail in that city. The investigator wrote as follows in regard to what he learned:

"Mr. Stubblefield has worked for ten years to discover an apparatus by which he could overcome the use of wires in telephoning, during which time he has be-

come a technical electrician of high order. He has kept in touch with all the leading electricians, and is familiar with every important discovery in the field of electricity. Naturally he has been a close observer of the work of Marconi.

"The transmitting apparatus is concealed in a box. Two wires of the thickness of a lead pencil coil from its corners and disappear through the walls of the room, and enter the ground outside. On top of the box is an ordinary telephone transmitter and a telephone switch. This is the machine through which the voice of the sender is passed into the ground, to be transmitted by the earth's electrical waves to the ear of the person who has an instrument capable of receiving and reproducing it.

"We went into the cornfield back of the house. After walking five hundred yards we came to the experimental station the inventor has used for several months. It is a dry goods box fastened to the top of a stump. A roof to shed the rain has been placed on top of it; one side is hinged for a door, and the wires connected with the ground on both sides run into it and are attached to a pair of telephone receivers. The box was built as a shelter from the weather, and as a protection to the receivers. I took a seat in the box and Mr. Stubblefield shouted a 'hello' to the house. This was a signal to his son to begin sending messages. I placed the receiver to my ears and listened. Presently there came with extraordinary distinctness several spasmodic buzzings and then a voice which said: 'Hello, can you hear me? Now I will count ten. One—two—three—four—five—six—seven—eight—nine—ten. Did you hear that? Now I will whisper.'

"I heard as clearly as if the speaker were only across a 12-foot room the ten numerals whispered. 'Now I will whis-

to play the mouth organ now,' said the voice. Immediately came the strains of a harmonica played without melody, but the

notes were clear and unmistakable. 'I will now repeat the program,' said the voice, and it did.

"An examination of the station showed that the wires leading from the receivers terminated in steel rods, each of which was tapped with a hollow nickel-plated ball of iron, below which was an inverted metal cup. The wire enters the ball at the top and is attached to the rod. The rod is thrust into the ground two-thirds of its length. Another test was made after the rods had been drawn from the ground and thrust into it again at a spot chosen haphazard by the correspondent. Again the 'hello' signal was made by Stubblefield, and after a few minutes' wait came the mysterious 'Hello! Can you hear me?' and



MR. STUBBLEFIELD RECEIVING MESSAGES BY WIRELESS TELEPHONE.

Note the two steel rods in the ground, which establish connection with the electrical currents of the earth, being connected by 30 feet of wire attached to the receiver.

tle,' said the voice. For a minute or more the tuneless whistle of a boy was conveyed to the listener's ears. 'I am going

a repetition of the program of counted numerals, whispers, whistling and harmonica playing.

“‘Now,’ said Mr. Stubblefield, who carried under his arm duplicates of the ball-tipped steel-rods. ‘I wish you would lead the way. Go where you will, sink the rods into the ground and listen for a telephone message.’”

“Away we went, down a wagon track, through the wide cornfield. A gate was opened into a lane between the hedge that bordered the field and a dense oak woods. We pursued the lane for about 500 yards and struck into the woods. I led the way. Into the heart of the woods we walked for nearly a mile. In a ravine I stopped. ‘How far are we from the house now?’ I asked. ‘About a mile,’ Stubblefield answered. ‘Place the rods where you will and listen for a telephone message.’”

“I took the four rods from Stubblefield. Each pair of rods was joined by an ordinary insulated wire about 30 feet long, in the center of which was a small round telephone receiver. Two of the rods were sunk in the ground, about half their length, the wires between them hanging loosely, and with plenty of play. I placed a receiver at each ear and waited. In a few moments came the signal and the voice of Stubblefield’s son. The voice was quite as clear and distinct as it was 500 yards from the transmitting station. The rods were moved here and there, but always the message came.”

Nathan Stubblefield comes from a family distinguished in his locality. His father was a lawyer, much respected in that part of Kentucky. His brothers are merchants and leaders in the community. But Nathan Stubblefield is another type. He cares only for his home, his family, and electricity. He educates his children in person, and after seeing that his family is well pro-

vided for, spends the remainder of his substance in electrical experiments.

His son, Bernard B. Stubblefield, 14 years of age, has been for four years his father’s sole assistant. He is a remarkable boy. His father has been his only educator, and the lad is now an expert electrician and reads abstruse works on electricity and technical electrical journals with the same zest that other boys read stories of travel and adventures. His father says of the boy that he would be able to carry out and finish this system of wireless telephony should the father die, so closely has he been allied with every step in its discovery and development.

“I have been working for this, ten or twelve years,” he said. “Long before I heard of Marconi’s efforts, or the efforts of others, to solve the problem of transmission of messages through space without wires, I began to think about it and work for it. This solution is not the result of an inspiration or the work of a minute. It is the climax of the labor of years. Of course I worked along the lines all the others are working. The earth, the air, the water, all the universe, as we know it, is permeated with the remarkable fluid which we call electricity, the most wonderful of God’s gifts to the world, and capable of the most inestimable benefits when it is mastered by man. For years I have been trying to make the bare earth do the work of the wires. I know now that I have conquered it. The electrical fluid that permeates the earth carries the human voice, transmitted to it by any apparatus, with much more clarity and lucidity than it does over wires. I have solved the problem of telephoning without wires through the earth, as Signor Marconi has of sending signals through space. But

I can also telephone without wires through space as well as through the earth, because my medium is everywhere.

"As to the practicability of my invention, all that I claim for it now is that it is capable of sending simultaneous messages from a central distributing station over a very wide territory. For instance, any one having a receiving instrument, which would consist merely of a telephone receiver and a few feet of wire, and a signaling gong, could, upon being signaled by a transmitting station in Washington, or nearer, if advisable, be informed of weather news. Eventually it will be used for the general transmission of news of every description. I have as yet devised no method whereby it can be used with privacy. Wherever there is a receiving station the signal and message may be heard simultaneously. Eventually I, or some one, will discover a method of tuning the transmitting and receiving instruments so that each will answer only to its mate.

— "I claim for my apparatus that it will work as well through air and water as it does through the earth. That it will convey messages between the land and sea, for instance, from lighthouses to ships, from vessels in any part of the ocean to vessels or their owners on land, if each carry my transmitters and receivers; it can be used on moving trains so that they may be spoken between stations and thus prevent accidents. There is no conceivable position or station in which they may not be used. The all-enveloping electricity, the medium of carriage, insures that. The curvature of the earth means nothing to me—it will not deter messages sent by my apparatus. I have shown what my machine will do through the earth by grounding the wires.

I will say that it is not absolutely necessary to ground the wires. I can send messages with one wire in the ground, the other in the air, or with no wires at all. In fact, my first and crude experiments were made without ground wires. I have sent messages by means of a cumbersome and incomplete machine through a brick wall and several other walls of lath and plaster without wires of any description. The present method of grounding wires merely insures greater power in transmission. Several years ago I invented an earth cell which derived enough electrical energy from the surrounding source to run a small motor continuously for two months and six days without being touched. There was enough energy in the motor to run a clock and other small pieces of machinery or ring a large gong. This earth cell can be greatly magnified. Its discovery was the beginning of my experiments with wireless telephony. The earth cell was merely buried in the ground and connected by wires with the motor. The earth's electrical currents supplied it with power. The expense of my wireless telephony apparatus will not be great—not greater than that used for ordinary telephoning, minus the present enormous cost of wiring."

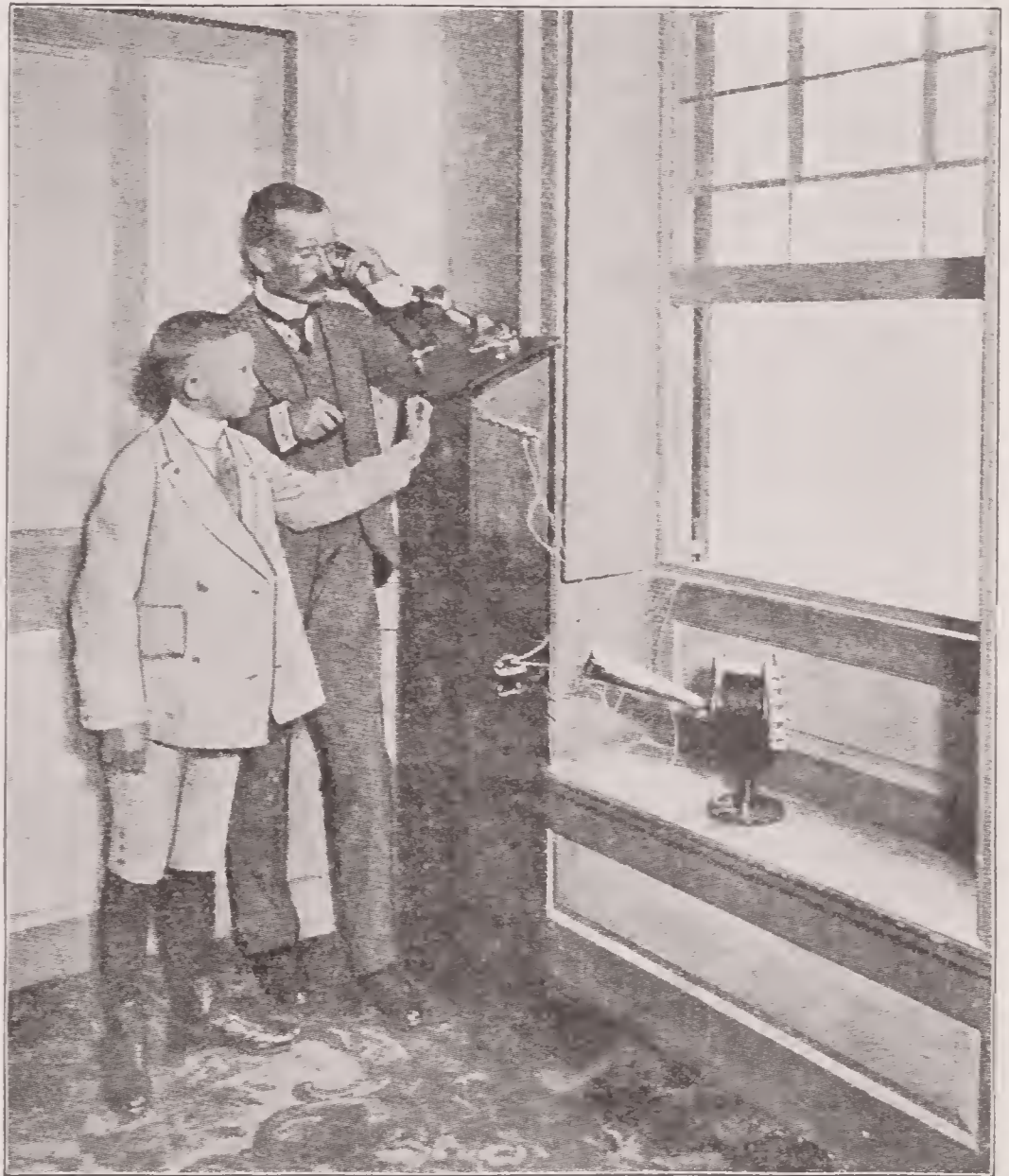
In May Mr. Stubblefield went to Washington and conducted a public test in the presence of a number of scientists and capitalists from New York and Chicago. These tests were made on board a steamer on the Potomac River and on land nearby. During the land tests, complete sentences, figures and music were heard at a distance of several hundred yards, and conversation was as distinct as by the ordinary wire telephone. Persons each carrying a re-

ceiver and transmitter with two steel rods, walking about at some distance from the stationary station, were enabled to instantly open communication by thrusting the rods into the ground at any point. An even more remarkable test resulted in the maintenance of communication between a station on the shore and a steamer anchored several hundred feet from the shore. Communication between the steamer and the shore was opened by dropping the wires from the apparatus on board the vessel into water at the stern of the boat.

An interesting article by Professor A. Frederick Collins, the well-known electrical scientist in the "Electrical World and Engineer," relates his observation of the demonstrations of wireless telephony and gives his opinion as to the practical value of the invention. He says in part:

"There are many instances where an ordinary telephone cannot be employed. As an illustration let me cite a few cases: Two families lived only 1,500 feet apart, and where telephones costing \$25 per pair would have answered the purpose, but

owing to a railroad operating the adjoining properties, permission could not be obtained to stretch the wires; as an experiment the wireless telephone was tried, and with success. Another case was in the Thousand Islands, where a cable was laid



NATHAN STUBBLEFIELD AND HIS SON TRANSMITTING MESSAGES BY WIRELESS TELEPHONY.

from an island to the main land, at a cost of \$2,000; here, again, a wireless telephone could have served the purpose at a cost not exceeding \$200. A third case is in Narbeth, where the borough officials will not permit the Bell Telephone company to erect

poles. Two physicians have had telephones in their residences for nearly a year, hoping that the Bell people would effect connection with their lines, one-fourth and one-half mile away. The contention was a matter of one narrow street. This distance could have been easily bridged by means of a wireless telephone; in fact, communication was established between one of the residences and the writer's laboratory, where three streets intersected the line of wave propagation, but as it took place under the surface of the earth, no one objected to it. But the most useful sphere of the wireless telephone, and the one which the writer has ever advocated, is its application to vessels in harbors. The wireless telephone is a first-hand instrument; it is simple, reliable, and it may be applied to any vessel at a comparatively small cost.

"The synchronization of wireless telephony is one of the knotty problems. It is this question that staggers the most sanguine; but if one had asked Professor Bell, in 1876, how any two of 40,000 subscribers might be put into instant communication one with the other, he, doubtless, would have found it difficult to even picture in his mind's eye the modern central station switchboard. It must be remembered that the wire telephone has had engaged in its improvement the brightest scientists, the most original investigators of the world for a period of over a quarter of a century, and this experience and application has brought the 'toy' to be one of the most potent factors of the commercial world. Would that a little of such applied energy could be put on the wireless telephone."

As an evidence that the practical value of the wireless telephone is recognized, the Gordon Telephone Company of Charleston,

South Carolina, promptly ordered a complete equipment to connect that city with the sea islands along the coast. Only a year before, that company spent \$25,000 in one winter to install and maintain its marine cables, and the president of the company estimated that an equally satisfactory service by wireless telephone would have cost but \$2,500 to install.

Wireless telephony stands in practically the same position that wireless telegraphy did prior to 1897, for the reason that its great value is not realized, since it has not been tried by the crucial test of commercial usage. As a consequence there are very few persons engaged in solving the riddle of making it an instrument of wide range and indispensable utility. Nevertheless, in England and France various inventors are now making experimental tests looking for the same results.

At the end of July, 1902, an English company announced its incorporation and immediate readiness to supply wireless telegraph equipment of the Armstrong-Orling system, claimed to be much simpler, cheaper and more perfect than that of Marconi. Wireless telephone apparatus also was offered by the same company, the complete outfit for short distances to cost but \$20, with a yearly royalty of \$5. Thus it is that the advance of science and invention fully keeps up with the most rapid material progress of the world.



PERPETUAL MOTION MACHINES

Perpetual motion was a will-o'-the-wisp that led philosophers, scientists and mechanics a merry dance for many years. Men of wide thought and deep learning

spent the best years of their lives trying to find the missing link which might give them a self-acting machine, that would produce power out of itself and by itself and yet never run down. The present generation of mechanics, however, have had little to do with perpetual motion. They have laid it on the shelf along with other demonstrated impossibilities and chimeras.

Occasionally some one will bring forward a combination of wheels, gears, levers and cams which he declares is a perpetual motion machine, but he receives nothing but jeers for a reward. In the earlier part of the nineteenth century, however, men believed that a self-acting perpetual motion machine was a possibility, and a century earlier many patrons of the arts proved easy victims of frauds and charlatans, who concealed spiral springs and clock work in the cases of their machines, and thus proved that they had discovered how to make an impossibility possible.

A favorite idea which the old-time perpetual motion enthusiasts thought to make practical was the overbalanced wheel, in which weights rolling down toward the rim on one side increased the leverage on that side, because the rolling weights moved toward the center on the ascending side. A simple test showed that the weights would not roll of their own accord, and the inventor bent his energies toward the construction of mechanism which would make the weights obedient.

Hydraulic power was the fundamental principle on which numerous perpetual motion machines were based, and pumps were connected with water-wheels in order that the water, having done its work on the wheel, would be pumped to a height to work over again. Capillary attraction was seized

upon by several perpetual motion mechanics as a source of energy, and levers, springs, screws, cams, eccentrics, weights, air, quicksilver, gas, the wind, heat, steam and magnetism were used for the purpose of bringing perpetual motion into the field of applied mechanics.

Some of the attempts made to secure the desired results produced machines curious and interesting. One of them used bellows which blew up bladders attached to the arms of a wheel in a tank of water. This was brought out in England in 1823, but as usual there was a missing link. Soon after this machine was given to the world another genius produced a combination water-wheel and a rotary pump affair, which he declared would certainly run itself, through all time. The Archimedes screw was utilized by another pursuer of perpetual motion. All of these devices were brought out during a widespread discussion in England of the mechanical possibilities of perpetual motion. The agitation was contemporaneous with the invention of the steam locomotive, and all England was excited over the possibility of power producers. Engineers, mechanics, scientists and chemists took up the fad, and perpetual motion was a living issue. Finally level-headed men combined to fight the crazy notion, and their exposures of the many frauds which were foisted on the people killed the chimera and it was placed in the grave with other picturesque hoaxes.

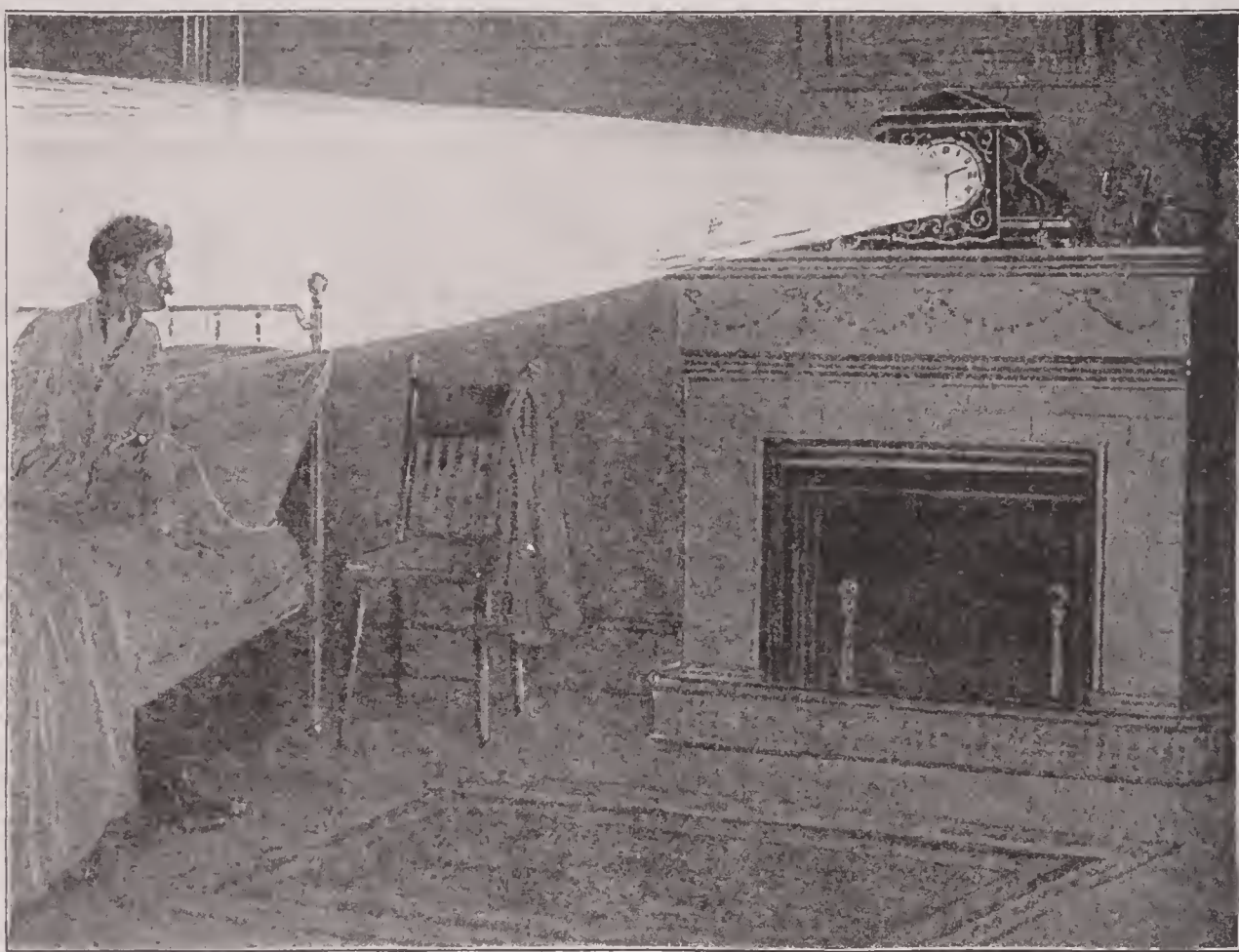


CLOCKS WHICH FURNISH LIGHT

If a recent invention in the way of time-pieces comes into general use, we will no longer need to be troubled by groping in the dark for matches, when we wake up in

the night and want to know what time it is. One of the big clock manufactories of the United States has begun to make and sell an ingenious time-piece called the Aladdin clock. The dial or face of the clock upon which the figures are painted to indicate the hours, and over which the hands pass as they turn, is made of translucent glass, a quality which does not make itself

tions. This push button is supposed to be safely stowed away under the sleeper's pillow when he retires, or else hung from the ceiling above his head or over the bedpost, as may be most convenient for him. Now let the darkness come when it will. If he wakes in the night to find an intruder in the room, or as a result of sleeplessness, a slight pressure on the button will flood the room



"ALADDIN CLOCK." EQUIPPED WITH ELECTRIC CONNECTION FOR NIGHT USE.

apparent under ordinary circumstances, because there is no light behind it, and consequently it appears like any other enameled clock dial. As a matter of fact, however, it is not so simple.

Behind the glass is an electric light, inside the clock, which is connected with a push button on the end of a long, flexible cord in the interior of which wires are carried after the fashion of electrical connec-

with light in a most mysterious fashion from this ingenious clock face, without any noise or without any stirring from his position.

It is quite evident that such a time-piece has several distinct advantages which are bound to make it popular for many uses. It is this sort of thing that may be termed a genuine "Yankee notion," and gains for the United States the distinction of being a

nation of ingenious and deft contrivers, who can improve anything if they will only give their attention to it.



ACETYLENE GAS

Within comparatively recent times a remarkably successful illuminant has been introduced under the name of acetylene gas. It has become familiar rapidly as a satisfactory light for buildings, both public and private, and has gained great popularity for carriage and bicycle lamps. Its brightness shows far through the night, and a bicycle lamp equipped with the acetylene light is readily distinguishable from its less brilliant rivals on the road.

Acetylene is generated when calcium carbide is put into water. Calcium carbide is a hard, porous, grayish material, produced by fusing pulverized coke and air-slaked lime in an electric furnace. One ton of this carbide makes 11,000 cubic feet of acetylene gas, which, it is said, is equivalent in illuminating power to 264,000 cubic feet of ordinary coal gas.

The processes of the manufacture of carbide are as follows: Two thousand pounds of lime and 1,500 pounds of coke are placed in an electric furnace, and the product is a ton of calcic carbide. The coke is crushed and pulverized by suitable machinery, and the lime is slowly air-slaked and then is thoroughly mixed with the coke. The electrical furnace is built of firebrick, and in it is a cast-iron crucible about two by three feet in size.

The cast-iron plate in the bottom is protected from the intense heat of the electric arc by a thick layer of powdered carbon, which is a good conductor of electricity but a poor conductor of heat. This plate forms

one of the "electrodes" or poles of the electric cable, which conveys the current to the furnace. The other electrode is a large pencil of carbon, which hangs vertically over the plate. It is so arranged that it can be lowered until the carbon touches the plate, or drawn up and out of the furnace altogether. It is connected with the other electric cable, both running from an alternating generator.

The carbon pencil is an important part of the outfit. It is made of six carbon slabs, each three feet long and four inches square, clamped together so as to form a composite pencil having a cross section of ninety-six square inches. The spaces between the carbon slabs are filled with powdered coke and coal tar, rammed down hard and afterward baked, so that the pencil is practically one piece of carbon and is used as such.

When the current is on, an electric arc, similar to that formed in an ordinary arc light but many times more intense, hotter and more brilliant, is formed between the cast-iron bottom plate and the great carbon pencil. The heat from this arc is so intense that it fuses the coke and lime into a solid mass.

When the furnace is ready to be charged the carbon pencil is lowered until it touches the bottom electrode, and the mass of combined coke and lime is shoveled in around it. Then the doors are tightly closed and the current switched on. So long as the pencil touches the bottom electrode nothing happens except that the current flows through the pencil and bottom plate without raising a disturbance. But a great change takes place when the attendant, by turning a hand-wheel, lifts the pencil a short distance from the bottom plate. The

current then leaps across the space and the electric arc bursts out, fusing the lime and coke around it, thus making calcic carbide.

As the fusing continues the pencil gradually is lifted higher and higher, for the calcium carbide is an excellent conductor, and the electric arc is maintained in all of its intensity. When the pencil has reached its highest point the current is turned off, and the contents of the furnace are allowed to cool. The product is in the form of a cone of calcic carbide, surrounded by the lime and coke which was outside of the influence of the arc. Although the heat of the furnace is intense, the coke and lime will not fuse unless it is in the fusing zone of the arc. The carbide remains unchanged in dry air, but if it is moistened it gives out a thick, heavy gas, which has a slight smell of garlic in it, and this is the acetylene gas.

The calcium carbide, when placed in water, forms a carbon vapor by the chemical combination of two parts of carbon with two parts of hydrogen. The oxygen combines with the calcium. The gas can be used in many ways. It can be distributed through street mains, as ordinary gas is distributed, but this plan is not regarded as the best, because of the great cost of installation and the leakage. The carbide cones themselves can be delivered to residences, and a small automatic generator connected with the gas piping of the house will take the place of the gas meter. It is easy to liquify this gas, and the liquid gas can be stored in small tanks, delivered to houses and tapped from reservoirs fitted with proper expansion valves. Plants for the manufacture of this gas for use on farms and country estates can be built at small cost, with the result that superior il-

luminating gas may be used far from the city.

The lamps for bicycle use have small compartments in which the carbide and water are kept separate, the water being allowed to drip through a very small hole, one drop at a time, and as the gas is generated it flows out through a jet where it is lighted. This gas gives out no odor or smoke when burning, but has a decidedly disagreeable smell if it escapes without being burned, and this odor will betray a leak instantly. The appliances for using it are being improved constantly to make it safe in handling, and there is no doubt that it is an important addition to the list of illuminants in general use.



FINDING VALUE IN CORN STALKS

It has long been realized that a valuable product of the farm was going to waste because of the failure to utilize corn stalks to good advantage. Little use has been made of them except as fodder and fuel, although it has been understood that they contain many elements of commercial value, if some method of making them available could be discovered. Many scientists have turned their attention to this matter, with varying success, until finally a process and a machine have been invented which seem to promise an important development in this direction.

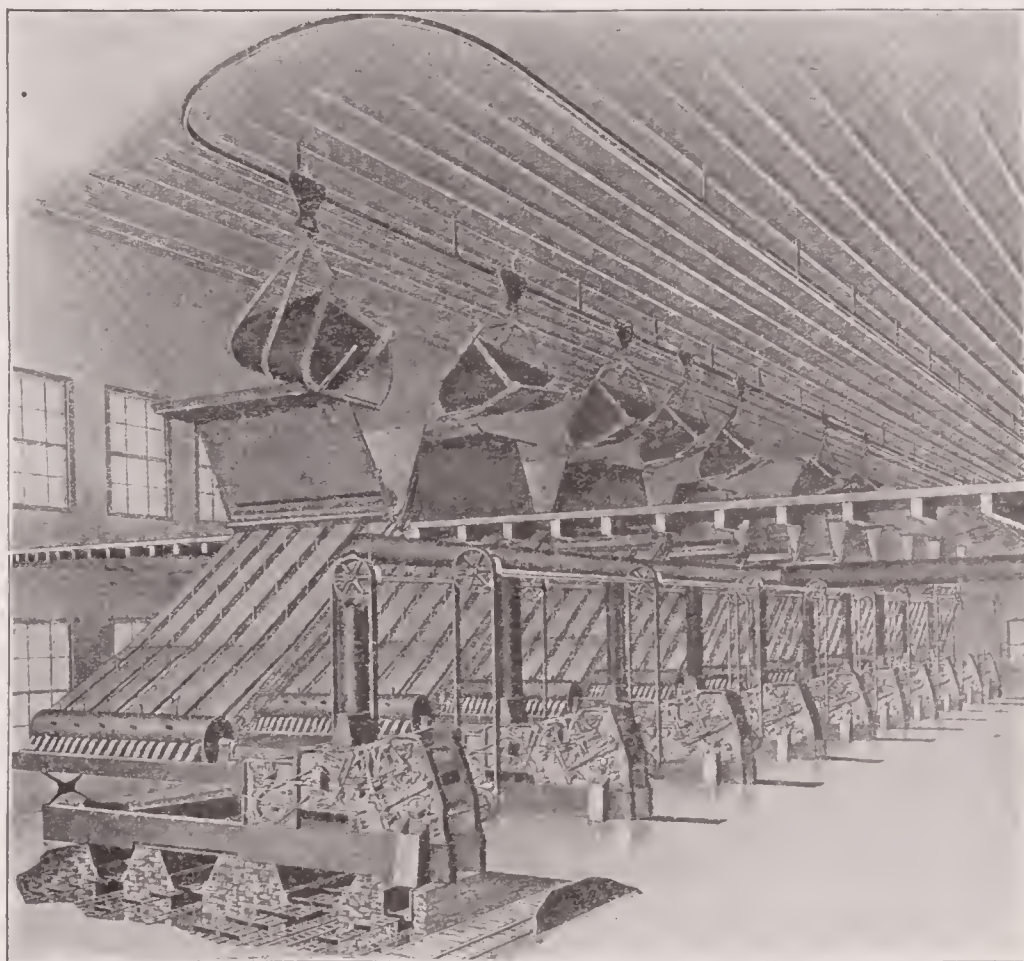
The farmers of the United States of America cultivate more than 80,000,000 acres of corn each year and this enormous crop, under present methods, has been raised almost entirely for the kernels. A few husks have been saved for mattresses, and a slight per cent of the fodder has been fed to stock, but it may be stated roughly

that of this great crop hardly more than one-half is saved and utilized. It is declared that by processes now developed the part which has been wasted can be turned into meat, paper, and other products of high value. The processes contemplate utilizing every bit of the waste portions of the product.

Each ear of the corn is covered with several layers of husks. Those next to the ear are fine and delicate; those on the outside are coarser. The finer husks have a commercial value outside of their use for feed, being worth several dollars a ton for mattresses and upholstery material. The leaves of the cornstalk are long and tender, and cure naturally in the field. They are of a high feed value, almost wholly digestible, as the per cent of fiber in them is small. The leaves, together with the coarser husks from the ear, are to be preserved in this process as valuable winter feed for stock.

The shell and pith of the stalk are direct opposites to the leaves in composition. When matured the shell becomes hard, dense and woody, and after being treated in a strong solution of lime will produce over sixty per cent of fiber from 100 pounds of stock. In fact there is almost no digestible matter in the shell after it be-

comes dried. Within the shell is the pith, which amounts to 23 per cent of the clean stalk. This pith has the power of absorbing liquid faster and in larger quantities than any other known substance. A pound of dried pith will absorb twenty-five times its weight of moisture. The stalk, shell and pith of the corn stalk are recognized as having virtually no food value, for an animal



MILL EQUIPPED FOR TREATING CORNSTALKS.

fattens on what it digests, not what it eats.

The ingenious machine which has been invented to utilize the waste products of the corn plant, separates all of these different elements with the utmost ease, so that each one of the by-products can be treated on its merits. The de-pithing machine, when stalks are fed to it as they are cut and brought from the field, snaps off

the ears and drops them on the husking-rolls, while the stalks themselves pass into another portion of the apparatus. The husking-rolls husk the ears, delivering them to a conveyer, and the husked ears pass into a cornerib. The husks themselves pass into the bin. The leaves are next stripped off the stalk and are then drawn from the machine to another bin. The dirt, too, has been cleaned away in the process. The clean stalk next passes into the de-pithing section of the machine, where the shell and the pith are separated and deposited on separate conveyers. Thus the component parts of the corn plant are separated, so that all can be used for whatever purpose they are adaptable.

It is believed that as these machines multiply there will be some remarkable developments in the manufacture of paper. To-day the forests of our country furnish most of the fiber out of which the ordinary grades of paper are made. These forests do not renew themselves, so that the supply of paper stock is rapidly being reduced. Successive corn crops, however, are raised every year on the same field, and with the shell and the pith of the corn stalk used in the manufacture of paper stock, there will be a noteworthy change in the paper trade. Not only paper, but a multitude of other articles made out of wood pulp can be made out of these hitherto waste products of the corn stalk. With these machines put into practical operation throughout the states of the immense corn belt, the farmer should find a great increase in his income from the corn fields. Hitherto the farmer has received his profit only on the ears of corn. If to this we may add several dollars an acre for what has been considered a waste product, it will go far to increase the

profits of farming in the Mississippi valley. It is estimated that the annual waste of corn stalks in the seven leading corn-producing states is nearly 60,000,000 tons, valued, if utilized in this manner, at three dollars per ton. An increase of \$180,000,000 in the farmers' income in these seven states annually would be an item of striking importance.

The tendency of great commercial undertakings in this age is to eliminate waste. The Chicago packing houses are famous largely because there is no waste permitted, but some use is made of every ounce of the animals slaughtered there. The utilization of what were formerly considered waste portions has made the great profit of those concerns. The utilization of the cottonseed for oil and cattle feed saves to the cotton growing states about \$60,000,000 a year, a sum contributed by what was but a few years ago an absolutely waste product, a nuisance to the planter, who was seeking some cheap way to get rid of it. Most careful attention should be paid to the development of this new process for utilizing corn stalks, in the hope that a similar saving will be made for the farmer of the north.



SAVING GOLD FROM SOOT

In 1900, while workmen were making repairs to the roof of a building in the Omaha plant of the American Smelter and Refining Company, they were amazed to find the shingles and boards covered with atoms of metal. One of the boards was taken to the assayer, who burned it, retorted the ashes and imparted the startling information that the metal was composed of gold, silver, lead and copper.

Other boards were burned with like results, and the mystery grew more perplexing. Finally some one standing on the roof of the building had occasion to brush from his coat sleeves flakes of soot which were dropping from the great, rolling clouds of smoke and gas emerging from the giant stacks near by, and found bits of metal, which gave an idea to those who were investigating the puzzle.

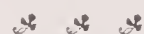
Sheets of common cheese cloth, cut to fit the interior of the stacks, were prepared. Through the center of the sheets were cut holes large enough to allow the necessary free draught. The sheets were fastened at various heights in the stacks and allowed to remain in position for several weeks. When removed and subjected to treatment the chemist produced gold, silver, copper and lead worth hundreds of dollars.

More cheese cloth catchers were inserted in the smokestacks, a few feet apart, one above the other, from the base to the crown. A semi-circular steel house was built, extending from the furnaces to the base of the stacks; a blower was placed in position to cool and force the smoke and gas through the steel house and up the flues. In its passage the smoke deposited in the steel house hundreds of pounds of grime, which was allowed to gather and pack for six months. That of the grime which managed to travel through the circular house and reach the flues was caught by the cheese cloth, a very small portion, practically, escaping to the outside.

When the steel house became filled with packed soot—highly inflammable—the mass was touched off with a common match and allowed to burn for several days, after which it was found that there still remained

in the inclosure many tons of a peculiar, dead-looking cinder, hard and worthless in appearance. This cinder was run through the furnaces, receiving treatment in the same manner as the original ores, and readily yielding its precious wealth.

Twice a year the Omaha plant gathers a six months "smokehouse and cheesecloth harvest," receiving 500 tons of cinder, which yields more than \$25,000. Fifty thousand dollars per year scattered over Omaha in smoke! That's what it has amounted to for twenty years.



THE MARINER'S COMPASS

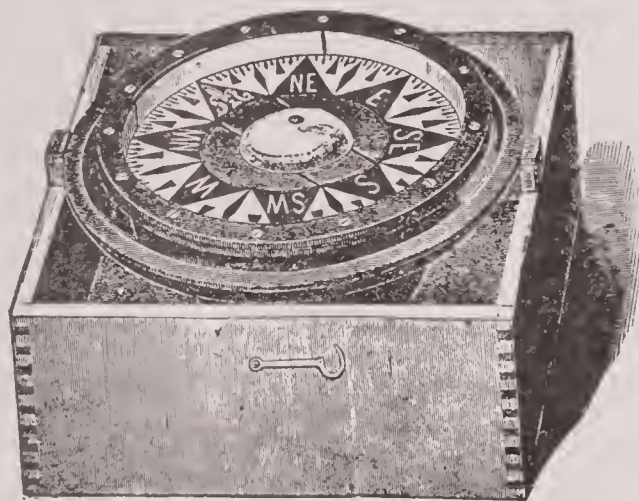
The mariner's compass frequently is referred to as an example of constancy and fidelity, and as an unerring guide whose "needle ever points to the north." The "needle which guides the travelers of unknown wastes" has been endowed by writers and poets with all of the virtues commonly supposed to reside in gravity, the earth's orbit, the sun, and other things unchangeable. As a matter of fact, however, the magnetic needle in a ship's compass does not always point to the real north; it is not "ever constant;" it is as susceptible to errors as other products of man's hands, and no navigator who knows his business will take his oath that his compass is absolutely correct at all times.

If the little bar magnet which swings in a compass were left undisturbed by outside influences; if it were delicately poised and nicely adjusted; if there were no iron, steel or other metals susceptible to magnetism in the vessel, and if the magnetic pole and the geographical pole were one and the same, the needle, probably, would ever and always

point to the north. But the magnetic pole is not the geographical pole.

The earth, itself a great magnet, has its negative and positive poles, just as the smallest horseshoe magnet, or the tiniest bar magnet has, but the earth's magnetic poles are always moving, and this movement, constant though slow, causes that "variation" which keeps navigators and scientists on guard, making observations, drawing magnetic charts, and searching for the cause of this pole traveling.

A bar magnet is a straight bar of steel which has been permanently magnetized. If a horseshoe magnet were straightened



THE MARINER'S COMPASS.

out, it, too, would be a bar magnet, with its positive and negative poles at opposite ends. Midway between the poles in a bar magnet is a point where the magnetism is neither positive nor negative. This is the neutral ground.

If a slender piece of wire, or a steel needle, is suspended in its center by a thread over a bar magnet, the negative end of that needle will point toward the positive end of the magnet, or the positive end will point to the negative pole. If the needle is held directly over the neutral part of the magnet it will hang horizontally—parallel with the magnet. If it is moved

toward one of the ends of the bar magnet one end of the needle will dip toward it, and the nearer it is moved to the end of the pole the more the needle will dip, and when directly over the pole it will dip as nearly straight downward as the thread will permit.

If that bar magnet is placed in a bucket of water so that it is just on the surface, and the needle is pivoted on a bit of cork large enough to make it float, the positive end of the needle will point toward the negative pole of the magnet, and the negative end toward the positive pole of the magnet. If the needle is floated opposite the center of the magnet, it will swing around parallel to it; as it is moved toward the pole one end will swing more and more, until the needle stands at right angles to the end of the bar.

If the magnet is placed under the surface of the water an inch or so, the needle not only will point toward the pole which attracts it, but will dip toward it also, and this is just what happens to the needle in a mariner's compass. It not only swings horizontally, but it dips downward also, just as though an immense bar magnet pierced the center of the globe, with its north and south poles sticking out at the magnetic poles of the earth.

To compensate for this dip, the compass needles or cards are provided with sliding weights, or other adjustments, so that they will be kept on a horizontal plane. From the poles of every magnet invisible "lines of force" shoot out and curve back toward the center of the magnet. The space cut by these lines of force is called the "magnetic field," and when in this magnetic field a freely poised needle will always place itself parallel to the lines of force.

From the magnetic poles of the earth, lines of magnetic force curve and twist out so that the whole globe is covered with them. Midway between the poles this magnetic force is weak, near the poles it is strong, so that the nearer a ship sails to a magnetic pole the steadier the compass becomes.

But there are other influences which affect the compass in a ship, and the most important one, outside of the variations of the world's lines of force, is the iron and steel which go into the making of a ship. No material has been found which will insulate the magnets in a compass, and the immense amount of metal in a ship serves as a large magnet to disturb the needle or magnetized steel wires in a compass. Many methods have been tried to correct the errors caused by iron and steel in a vessel, but the careful captain trusts to nothing but eternal vigilance and constant testing.

The little pocket compass, with its trembling needle shivering on its pivot, would not be able to meet all of the requirements for a ship's compass. In fact, the ordinary compass used in the wheel house of a vessel has no needle at all, for the magnetic steel bars which are used are concealed in the "card" that seems to swing from one side to the other with every movement of the ship.

As a matter of fact, the card is stationary. It is the vessel which moves, and an optical illusion gives motion to the card. A standard compass, such as is used on ocean vessels, is a complicated piece of sensitive mechanism compared to the little pocket compass which boys delight to carry.

The case which holds the compass is the binnacle, and it is fastened securely to the deck of the vessel or the floor of the wheel

house. It is provided with a lamp which is so arranged that it throws its light on the card in the compass, and nowhere else. The compass proper swings on two rings. The arms of the outside ring have knife edges, which rest on the binnacle. On this ring the arms of the inside ring are suspended, so that the compass is always held level, no matter how much the vessel rolls and pitches, for the two rings make a sort of universal joint.

The inner ring holds the copper bowl in which is the card. The card rests on a brass spindle which supports it on its upper end. The card consists of a metal rim, somewhat dished, on which the points and degrees are marked. Several brass tubes, four generally, extend across the space within the rim, and these tubes are exactly parallel with a line drawn from the point "N," which indicates north, and "S," which indicates south. Between the two central tubes, and exactly in the center of the space, is a brass bulb in the bottom of which is a hollowed-out sapphire or some other equally hard stone, which rests on the point of the brass spindle. In the brass tubes that extend from one side of the rim to the other, are little steel wires which are the bar magnets, the soul of the compass. The copper bowl that contains the card, spindle and steel magnets, is filled with a liquid composed of distilled water and alcohol, and the top is covered with a piece of clear glass, so that the copper bulb is hermetically sealed.

The card thus not only rests on the brass spindle, but also partially floats on the liquid. This reduces the weight on the spindle to a minimum, holds the card steady, and serves to compensate for the "dip" when the vessel sails nearer the mag-

netic poles. The "lubber's point" is a mark made in the compass, which is in line with the keel of the vessel, and this point indicates the direction which the vessel is sailing. The man at the wheel is ordered to keep the ship on a certain course, say due "north." With his eye on the card, he brings the lubber's point and the point marked "N" on the card together, and when, by reason of the wind, wave, or tide, the lubber's point moves to one side or the other of "N," he gives the wheel a turn or two and brings the points together again.



THE NAUTICAL ALMANAC AND ITS IMPORTANCE

An essential adjunct to the various instruments used by navigators for the safe handling of ships at sea, is a volume called the Nautical Almanac or the American Astronomical Ephemeris. To a layman this is merely a dull and complicated collection of mathematical tables, but to the navigator it is a handbook of the highest value.

The business of the Nautical Almanac is to predict, one or more years in advance, astronomical phenomena, the actual occurrence of which is recorded at the observatory, for the use of seamen while on the otherwise pathless sea. The compass alone is not a sufficient guide for the navigator. It simply informs him in an imperfect and uncertain manner of the direction of the cardinal points, but does not give him the slightest information respecting his actual position. That can be found out only by consulting the heavenly bodies, and that the observation may be practical, the position of the heavenly bodies at that exact

time must be known with a high degree of accuracy. Those positions are given in the Nautical Almanac, which is thus an absolute necessity for seamen.

The determination of longitudes at sea by the method known as the "lunar observations," the only method employed in the common practice of navigators where chronometers are wanting, or are untrustworthy, or require verification, depends essentially upon the accuracy of the moon's predicted place.

The superintendent of the Nautical Almanac is Professor Simon Newcomb, one of the most eminent scientists and astronomers in the world. He is assisted by various other computers, mathematicians and astronomers. Professor Newcomb outlined the development of the Nautical Almanac from the beginning of scientific navigation in an interesting interview.

"Although the theories of Ptolemy were founded on a false system," said Professor Newcomb, "they sufficed to predict the position of the sun, moon and planets with enough accuracy for the calculations of astrologers.

"The great Kepler was obliged to print an astrological almanac in virtue of his position as astronomer at the court of the king of Austria, but notwithstanding the popular belief that astronomy had its origin in astrology, the writings of astronomers proper in all ages show that they never had any belief in astrology. Kepler himself submitted to the humiliation of preparing this almanac only through pressure of poverty. Subsequent ephemerides, giving the longitudes of the planets, the position of the sun, the time of its rising and setting, the eclipses, etc., were issued by Kepler and his successors from time to time at

irregular intervals. The earliest regular ephemerides, so far as I am aware, was the French Nautical Almanac, first issued in 1679 by Picard. It has been continued without interruption to the present time. The first issue of the British Nautical Almanac appeared in 1766, and the United States Government undertook the work for the benefit of our seamen in 1849 under the superintendence of the late Rear-Admiral Davis.

“There are signal advantages to be derived from the Nautical Almanac which concern the navigator, surveyor, astronomer, and geographer. One of them relates to the tides. The conduct of a general system of tidal observations, their deduction and their scientific discussion, by which are evolved the rules for the prediction of the tides, are all the property of the hydrographical and astronomical departments of the coast survey. But it is the province of the Nautical Almanac to present the results of these various labors in a manner suited to answer the practical demands of navigation and engineering. We were formerly indebted to observations and deductions made in France and Great Britain for the principal part of our knowledge of these interesting and important phenomena. The tide tables of the American Statistical Almanac and Repository, as well as those of the numerous other popular almanacs published in this country, which consist almost exclusively of the times of high and low water, are derived directly from the tide tables of the British Almanac, computed, of course, without any reference to our own coast and its peculiarities.

“But it will be readily perceived that if the results obtained by La Place on the east side of the channel are not applicable

to the British shores and harbors, still less are those derived from observations made on the east side of the Atlantic likely to represent the real phenomena on the American coasts. In order to be able to give rules practically useful to the pilot, engineer and seaman for applying to the ordinary tides corrections depending on the moon's varying distance and declination, it is necessary to know to what meridian passage, or southing of the moon, the tide is due; or what is the distance from the land of the general tide-wave that causes the local tide which the observer is actually registering; or, in short, what is the age of the tide when it arrives at any particular part of our coast. That knowledge is the result of the careful study of a large number of observations made at various points. The age of the tide at London differs from that at Key West, and that at Key West, again, from that of New York or Hampton Roads.

“The Nautical Almanac, published annually, each number of which consists of between 500 and 600 pages, embraces all the elements necessary for determining at any time the absolute and relative places of the sun, moon and seven principal planets, and of many of the largest and most useful of the fixed stars, together with several different series of phenomena for the determination of longitudes, such as occultations of fixed stars and planets by the moon, the distances of the moon from the fixed stars and planets, the combined transits of the moon and certain fixed stars, eclipses and configurations of Jupiter's satellites, etc. To these are added the places of the minor planets and their elements, with rules and tables for practical use in nautical astronomy and land observa-

tions, new rules and methods whenever invented, tables of tides, and a chapter explaining the plan of work and the mode of applying its various parts in practice, in which is included some elementary scientific instruction.

"These details are the results of numerous laborious and complicated calculations. Strict and uniform accuracy is an indispensable requisite. In the case of the mariner, errors expose life and property to danger, and in that of the astronomer on the land they cause a waste of time and labor, and not seldom the irretrievable loss of valuable opportunities. None of the precautions, therefore, that experience has pointed out for the attainment of correctness and for security against mistake, is neglected.

"The Nautical Almanac is stamped by this circumstance with a peculiar character. Unfailing precision and exactness are the absolute conditions of its usefulness. But every person of experience knows that neither such extensive computations nor the printing of so many figures can be conducted with entire freedom from error, and to remedy this defect, inherent in such productions, the errors detected are printed and the corrections applied in subsequent volumes, probably before the first comes into general use.

"The calculations of the Nautical Almanac in reference to the sun, moon, and principal planets are, in the case of each one of them, based upon our own knowledge of their motions and the laws by which they are controlled, derived from the general theories of celestial mechanics, and from observations which, while they test the truth of the general theory, lead to the discovery of new facts and data, to the de-

tection of other laws, and to the inference of new generalizations.

"The observations employed comprise all the calculations of good authority which, from age to age, have accumulated in the rich treasury of astronomical science, ending with the latest publications of existing observatories and going back to the beginning of authentic history. In order suitably to convey our knowledge of the laws governing the motions of the heavenly bodies, and regulating their more or less rapid change of place, and to put this knowledge in a form adapted to the wants and uses of the computer, numerical tables have to be prepared, of the sun and the planets separately, which constitute the abbreviated expressions of these laws.

"The numerical tables greatly facilitate the labor of computations. They are the computer's tools of trade. To construct the tables; to make, compile and arrange the observations; to discuss them; to discover and investigate the theories and laws, and to invent that kind of logic, the higher mathematics, by which alone such investigations can be profitably pursued and their results succinctly defined, have been the occupations in every enlightened age, of the most illustrious genius and the most exalted talents. And a correct and well-conducted astronomical ephemeris, which comes up to the latest standard of modern improvement and discovery, is to be regarded as the full exponent of all this human thought and labor.

"The primary motive for computing and publishing the Nautical Almanac was to promulgate the lunar method for determining longitude at sea, and to furnish the requisite elements and precepts for the computation of this problem. This was as

early as the year 1767. Its appearance created a new era in navigation, to which it is now acknowledged to have rendered more essential service than anything else ever undertaken.

"On the one hand it is a text-book of the navigator. It informs him of his place on the ocean, where there are no other guides than the sun and stars. It is his intellectual rudder and compass; without it no shipmaster leaves the shores of the United States. When he loses sight of the last lighthouse or headland he turns to that for his further direction. On the other hand it is the vade mecum of the astronomer, whether stationary or traveling. He learns from it in the fixed observatory how his instrument must be set that he may see any particular body, and what is the precise moment for observation; and in the movable observatory he turns to its pages to ascertain how, on any given day, he can best determine his latitude and longitude, the astronomical bearings of his stations, and the rate and error of his chronometer. Thus, as the tables of the almanac owe their origin to the labors of the observatories, so they repay the obligation by affording the most ready and complete facilities by which those labors are at the present time safely and expeditiously conducted."



THERMOMETERS AND THE MEASURES OF TEMPERATURE

The average thermometer is as unreliable as an April day. Its column of mercury may indicate the proper degree of temperature, and it may be 10 degrees off. This is because the average thermometer is a cheap thermometer; it is one of a batch made as cheaply as possible, to be sold at a low fig-

ure. A man who owned what he thought was a first-class thermometer because it was set in a ground glass frame, made a rash bet with a neighbor who had a good-looking thermometer hanging outside his window.

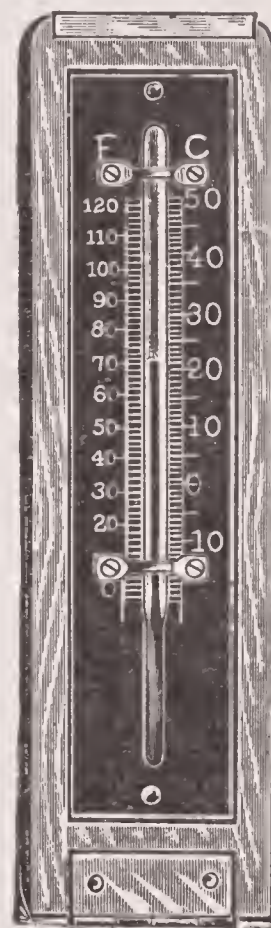
He bet that a comparison with a "standard" thermometer would show that his temperature indicator was correct within half a degree. The test was made and he was surprised to find that his pet thermometer had been telling lies every day for over a year. It was six degrees high.

"That's a summer thermometer," said the dealer in scientific instruments. "It gives you good grounds for bragging that the temperature on a hot day is 100 in the shade." Then he loosened the metal scale, slipped it down six points and said:

"Now it is more nearly correct. It's close enough for you, but it would scarcely do for precise work where readings of one-hundredth of a degree are made."

In making a mercurial thermometer of the better grade a piece of hard glass tubing is selected. The bore is critically examined, for it must be narrow, and uniform in diameter from one end to the other. The bore may be perfectly round or elliptical, but whatever its shape it must not vary in its size.

The uniformity is ascertained by meas-



Thermometer with Fahrenheit and Centigrade scales.

uring a short column of mercury at different points in the tube. If the glass tube is acceptable the bulb, which serves as a reservoir for the mercury, is blown in one end. The bulb varies in form, size and thickness according to the purpose for which the thermometer is intended. It may be spherical, pear-shaped, oval, cylindrical or tubular. It sometimes is made apart from the stem and afterward is joined to it.

This method is preferred for making thermometers in which the nicest precision is required, for then the bulb having the right capacity can be selected.

The glass-blower who makes a specialty of thermometer bulbs pays close attention to the thickness of the walls of a bulb. If the glass is too thin the bulb will yield to atmospheric pressure and raise the zero point; if too thick, the bulb will not be sensitive enough to variations in temperature and the thermometer will be of little value.

When the bulb is properly blown and fixed to the end of the glass stem, a second bulb is blown a short distance from the other end. This second bulb comes into use when the mercury is put into the stem and bulb of the thermometer. This is done at the time the second bulb is made, for before the glass is half cooled, the open end is plunged into the mercury, which gradually rises in the tube. The tube is allowed to cool, and again is heated, more mercury is "sucked in," and so, by judicious heating and cooling, the lower bulb is filled.

A wire handle then is bent around the tube to hold it while it is heated over a suitable furnace until the mercury boils, and boiling expels the air in the tube. The open end of the tube is kept cooler than the

stem and lower bulb, and while the mercury is boiling, some sealing wax is placed over the open end. This seals the tube and prevents the air from entering.

When the partly made thermometer is cooled, the quicksilver fills the tube and bulb below the upper bulb. The lower bulb is then heated until the mercury expands and runs into the upper bulb, and just as the column of mercury begins to go back in cooling the glassblower hermetically seals the tube just below the upper bulb, which is then drawn off. This leaves the mercury in a vacuum in the tube, and the thermometer is ready to be graduated.

This is not done immediately, however. It is stored for some time and heated for several days to 50 or 100 degrees above the temperature it is intended to indicate. There is a good reason for this, because if a thermometer is graduated soon after it is made the "zero" point rises in a short time, and is incorrect from $\frac{1}{2}$ to 3 or more degrees. This is due to the imperfect elasticity of glass.

Glass when heated expands, but does not return to its former dimensions for some time after it is cold. In a few months after it has been filled a thermometer bulb shrinks. This shrinkage reduces its original capacity and, of course, squeezes the mercury up into the stem, causing the zero point—the basis of the graduation—to rise, and thus throwing the entire thermometer out of "true," as a mechanic would put it. For this reason the graduation is deferred until the glass has settled into a normal condition. When this period of probation is at an end the thermometer is ready to have its degrees marked on it.

Two points are fixed. The lower usually is taken first. It indicates the freezing

point of water, and on the Fahrenheit scale, the one commonly used in the United States, is 32 degrees above zero. The higher point indicates the boiling point of water, and on the Fahrenheit scale is 212 degrees above zero. Water the world over freezes at the same temperature, hence it gives an accurate and easy standard for setting a mark from which to graduate thermometers. Water at the same altitude always boils practically at the same temperature, so that water, under two different conditions, can set the two marks on a thermometer. The freezing point is found by placing the thermometer vertically in finely pounded melting ice, contained in a vessel which permits the water to drain away. The whole of the mercurial column is plunged into the ice and kept there for half an hour. Then it is lifted just high enough to show the top of the mercury, and its position is marked, and that mark represents 32 on the scale. The temperature of boiling water is the higher fixed point. The thermometer is immersed in the steam of water boiling freely, and when the mercury refuses to rise higher the point is marked, and this point is 212 on the scale.

The space between the lower or freezing point and the upper or boiling point is divided into 180 degrees, and this division is carried below the freezing point 32 degrees to mark the zero point.

The centigrade scale is used largely in Europe and by chemists and scientists in America. In this scale the freezing point is zero and the boiling point is marked 100. The space between is divided into 100 degrees. In the notation employed for thermometer readings "C" is the abbreviation used for centigrade and "Fah" for Fahrenheit. Reaumur thermometers, used in Ger-

many, Russia, Holland and other parts of Europe, are graduated from 0, freezing point, to 80, boiling point. The centigrade system of graduation is becoming more popular every year. The countries which use it most are those which employ the metric system of weights and measures. Until we adopt the latter, we shall probably continue to measure our temperature by the less logical Fahrenheit scale.

Some thermometers intended for use in very cold countries have determined on their scales a point much lower than any marked on ordinary thermometers. It is the freezing point of mercury, and mercury freezes at 40 degrees below zero. This low point is determined as follows:

From seventeen to twenty pounds of mercury are used for the freezing mixture, and it is first cooled down to about 10 degrees below zero. Carbon dioxide is a gas which is capable of being liquefied under great pressure. When this liquid is permitted to expand freely into gas again it forms artificial snow, intensely cold. To freeze the mercury, liquid carbon dioxide is used. The gas is allowed to escape for about a minute, during which time about 550 grains of solid carbon dioxide are deposited in the form of snow. This is laid on the surface of the mercury, together with some ether. When it is all mixed together, the liberated gas and ether vapor, escaping through the mercury, cool it down and cause it to solidify on the surface, which is then stirred in. This causes the mercury to become pasty, and then the thermometer is plunged into the frozen quicksilver, and thus the point of freezing mercury is determined. For low temperatures alcohol is most suitable, as it does not become solid until -130.5 degrees is reached.

ROUEN'S AIR FERRY, ODDEST OF BRIDGES

Rivers have played an important part in the development of civilization. They have been the highways of communication by which mankind has explored the world,

these paths of nature for their prosperity.

Not to be hemmed in and limited by the rivers which served them so well, men early had to devise some means of crossing them regularly, rapidly and safely. So the very beginnings of civil engineering may be found in this necessity of establishing some

way of crossing rivers. Among the means which the engineer has hitherto employed to cross rivers and channels are boats or ordinary ferries, swing, draw, bascule and ordinary bridges, tunnels under the beds of channels and traveling carriers.

The "Pont Transbordeur," or overhead ferry, which has been built and is now in successful operation over the River Seine, at Rouen, France, represents the solution in a novel way of one of the most interesting problems in engineering. There is nothing like this overhead ferry in



FERRY ACROSS THE RIVER SEINE AT ROUEN, FRANCE.

extended settlement and transported products, long before railways began in part to supplant them in importance. At the mouths of the rivers grew the ports where commerce interchanged between sea and land, and so the world's greatest cities in large degree have been dependent upon

any other country in the world.

The swing, draw and bascule bridges can be safely used only over locks, inland canals or rivers, where a vessel can be under perfect control in all kinds of weather. Ordinary bridges are more satisfactory than the others, but if they are to cross a

river leading to an important harbor they should be of a height to permit a ship with the tallest mast to pass under. Some masts are 200 feet above the water. Inclines or elevators must be used to reach the bridge level, and the reason that there are so few bridges like the Forth Bridge in Scotland and the Brooklyn Bridge is their great cost. The objection to tunnels is the great cost and risk in building. Many large tunnels under water have been abandoned, and even when built they are not greatly appreciated by the general public.

The overhead ferry system remedies all these drawbacks. The advantages of the system are: The channel to be crossed is left entirely clear at all hours, without requiring vessels to make any special signals or modify their rate of speed any more than they would in the case of a cross-channel ferry. No increase of distance or ascent or descent is forced on the traffic in order to cross from one shore to the other.

The essential part of the system may be described as a horizontal railway supported by a bridge spanning the channel and built up at such a height as will allow the tallest masted vessels frequenting the channel to pass beneath.

The platform of the bridge carries two lines of rails, over which a carriage on small wheels rolls, the number of wheels varying with the weight to be carried. The rollers are connected with a movable frame under the line of rails, which may freely move in a longitudinal direction quite close to the platform and from one end to the other of same. Thus is provided a rudimentary vehicle which can cross the channel without interfering in any way with the opening which is to remain clear.

In order to obviate any swinging motion

which might result from the pressure of the wind or the forward motion of the carrier itself, the rods by which the latter is suspended are arranged in triangles, both in the longitudinal and transversal directions. There is thus a little railway for crossing the river, with this difference, that the body of the vehicle, instead of being above the rails and wheels as usual, is some 140 or 160 feet below these. All day and all night this peculiar car travels back and forth across the Seine, proving its efficiency by handling a large traffic without delay or accident.

The Rouen bridge ferry offers an interesting contrast to the tower bridge of London, the elevator bridge of Chicago, and the great Brooklyn bridge, all of which are pictured in this volume.

Siberia is traversed by a great number of large rivers, and travel through the sparsely settled country has not been sufficient to warrant the construction of costly bridges, nor yet to maintain expensive power ferries. These conditions have established a novel and cheap form of ferry which is commonly found in that great northern land. The ferry boat to be utilized is anchored in the middle of the river by a cable about three times as long as the width of the stream from bank to bank. The boat, of course, swings with the current down stream from the place of anchorage. By merely steering with the rudder, the ingenious boatmen make use of the current itself to drive their craft to one shore or the other, back and forth at will, on the arc of a great circle. A landing at either side is prepared, and they are ready for business, with true economy of power. For several months in the year these rivers are closed by ice, when sleds supplant the ferries, which await the return of summer.



IRRIGATION METHODS IN AN OASIS IN THE SAHARA DESERT.

Water is life in the desert to a degree that we do not realize in our more favored land. This crude machine, turned by camel power, raises water from the little stream to the irrigation ditches, which distribute it among the fields which produce the most luscious of fruits and the other crops on which the desert tribes live.

BOOK III

Marvelous Peculiarities and Noteworthy Facts of all Nations and Countries of the World

SETTLEMENTS AND MIGRATIONS OF NATIONALITIES IN THE UNITED STATES

“From whence came we?” may not be so interesting to us as, “whither do we go?” but it offers some curious facts as to “who are we?”

At the close of the Revolutionary War, there were probably but little more than

three million persons composing the new nation. It is estimated that from the Declaration of Independence until the census in 1820, there were not more than 250,000 immigrants, although there were enrolled at that time a total population of



THE AMERICAN LIBERTY BELL, LEAVING PHILADELPHIA FOR A GREAT EXPOSITION.

9,638,453. From that census up to 1902, there came into the United States a little more than 21,000,000 immigrants, from nearly a hundred different nations, thus, with the natural increase, bringing the population up to nearly eighty millions in 1902.

The colored race in the United States, being free from addition by immigration, except in the time previous to 1800, shows a remarkable ratio in the increase by birth, notwithstanding the fact that their death rate is estimated to be much greater than that of the white people.

In 1790 there were 757,208 colored persons in the United States; in 1840, 2,873,648; in 1890, 7,470,040, and in 1902, an estimated number of about 9,000,000. They were first brought as slaves, 20 in number, to Jamestown, Virginia, in 1619. In 1624 there were but 24 in the colonies; in 1648 there were 300. Then their service as tobacco raisers caused them to be imported in great numbers.

Although the Spaniards made permanent settlements at St. Augustine in 1565, at Santa Fe in 1581, and at New Orleans in 1763, they never increased in numbers and so have made little impression on the general civilization of the country.

The English began their settlement at Jamestown, Virginia, in 1607, but during the rule of Cromwell, the cavaliers or adherents of the Stuarts, came over in such numbers that their character was given to the social and political nature of the whole population. The descendants of these people moved west and their spirit dominated the western belt, covering Kentucky and Tennessee.

Under the persecutions of the Stuarts, the Puritans to the number of about 21,000

came to America, spreading from the first settlement made by them at Plymouth, in 1620, among numerous branches. The descendants of these likewise moved west, and it is estimated that at least 13,000,000 residents of the north trace their ancestry to those sources.

The French came from Canada to the Mississippi Valley and finally made a permanent settlement at Saint Louis in 1764. They had come already, in 1718, in considerable numbers from the French West Indies to New Orleans. They have had no perceptible migrations, but their influence along the track of their first settlements has been widely felt.

- The English Catholics came to St. Mary's in Maryland, in 1634, and their line of migration can be distinctly traced along the Ohio Valley, but they chiefly populated the surrounding region.

The English Quakers came to Philadelphia in 1683 and their influence was for nearly two centuries dominant throughout Pennsylvania.

The English debtors and paupers who were taken to Savannah in 1733 went westward and settled the interior portions of Georgia and Alabama, the line extending on through into Arkansas and Missouri.

The Dutch settled the present site of New York City in 1613. Not having a migrating character, they remained to become the chief social and commercial factors of the metropolis. Three presidents of the United States are of that ancestry. Some of the poorer classes moved westward into Pennsylvania where they still retain many of their old customs.

The Germans made their first settlement at Germantown, near Philadelphia, in 1683. The ground was bought from Will-

iam Penn by Jacob Telner of Crefeld, a town on the lower Rhine near the boundary line of Holland. They were members of the sect known as Mennonites. Since then the immigration from Germany has exceeded that of any other nation.

The Hebrews came first to New York in 1654, from Brazil, twenty-seven in number. Their baggage was seized on landing to pay their passage, and this not being sufficient, two of their number were seized and imprisoned till the remainder was paid. On July 7, 1733, while Governor Oglethorpe and his colonists were assembled at a public dinner on the present site of Savannah, forty Hebrews from London sailed up the river, landed there and proceeded to make themselves at home. It created a sensation, both among the colonists and the London owners of the land, but Oglethorpe was their friend and they remained to become the most influential citizens of the South Atlantic seaboard.

In 1638 the Swedes formed a settlement on the Delaware River, but were compelled to give up their charter to the land, between the encroachments of the Dutch and the claims of the Quakers.

Italians, Chinese and other immigrants who did not come to make this country their home, nowhere have become fixtures as citizens or influential factors in civilization, except in isolated instances.

The Norwegians were among the latest of the permanent additions to the population of the country.

The Albany Patriot of October 24, 1825, contained the following news item: "On Saturday, as we are informed, the Norwegian emigrants that lately arrived in a small vessel at New York, passed through this city, on their way to their place of

destination. They appear to be quite pleased with what they see in this country, if we may judge from their good humored countenances. Success attend their efforts in this asylum of the oppressed."

These fifty persons were the first Norwegians to settle in the United States, and their destination was Murray, now Kendall, in Orleans County, New York. Their line of migration was southwest, reaching as far as Central Illinois, with a few families in Kansas and Missouri. In later years they have settled in the states of the upper Mississippi valley.

The Irish immigration began with the revolution and was without record, previous to the census of 1820. It was confined almost wholly to the cities, of which New York was the center. No other nationality has had such a large share of influence on the politics of the Nation.

According to the census of 1900, the principal foreign-born population of the United States was as follows: Germans, 2,600,000; Irish, 1,780,000; British, 1,245,000; Scandinavians, 1,040,000; Russians and Poles, 700,000, and other miscellaneous nationalities to the total of 10,160,000.



GREATEST FACTS IN THE HISTORY OF THE UNITED STATES

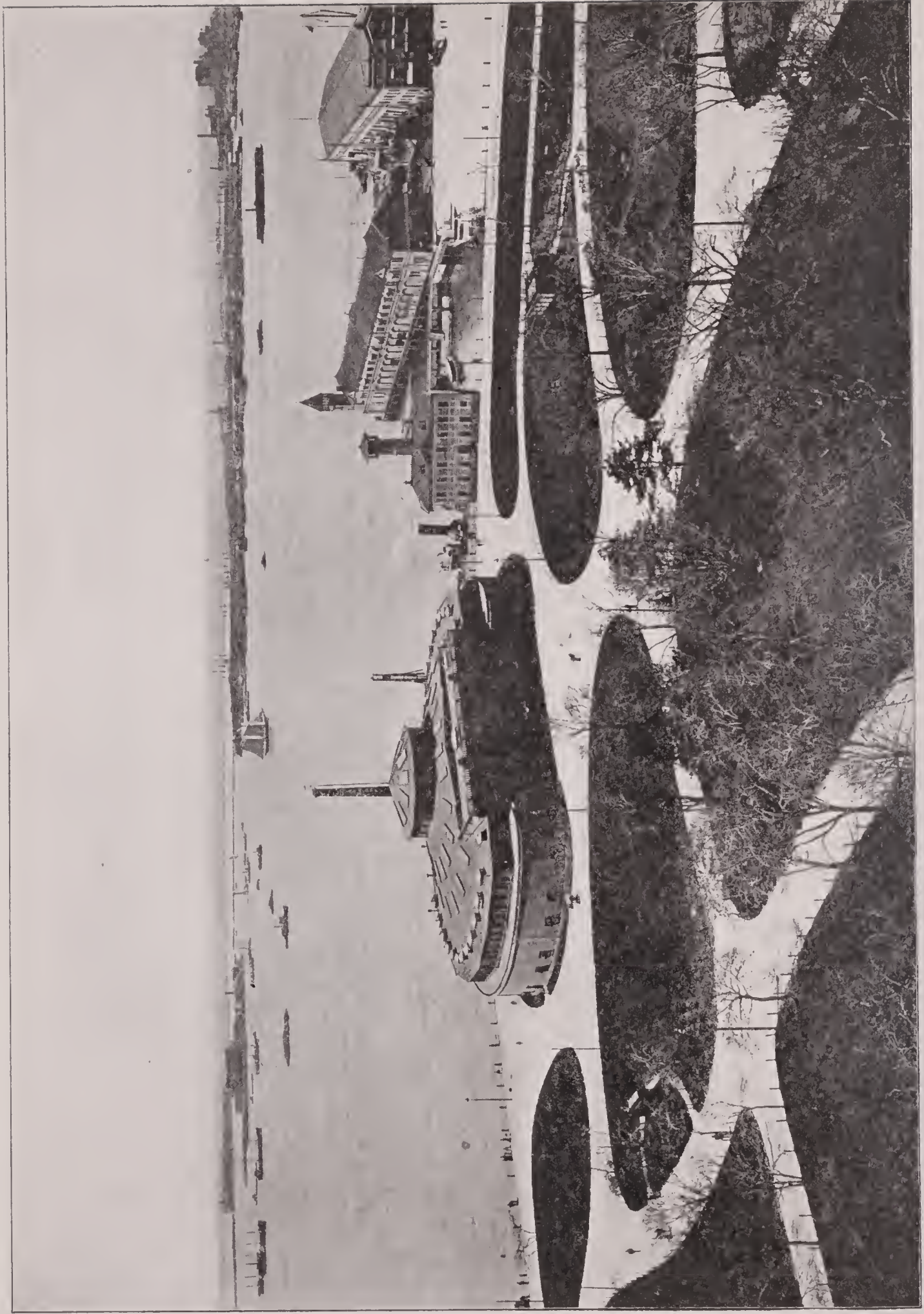
Types of civilization in first settlements:

The French at St. Louis, Feb. 15, 1764, at New Orleans in 1718.

The Spaniards at St. Augustine, in 1565, and at New Orleans in 1763.

The English cavaliers at Jamestown in the settlement made in 1607.

The English Puritans at Plymouth in 1620.



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CASTLE GARDEN AND BATTERY PARK, NEW YORK CITY.

This is the extreme southern end of Manhattan Island on which New York stands. The oval building is Castle Garden, which for many years was the receiving station for immigrants until superseded by Ellis Island, in the bay. The buildings to the right are steamship piers, and across the mouth of the North River, or Hudson, Jersey City appears.

The English Catholics at St. Mary's in 1634.

The English Quakers at Philadelphia in 1683.

English debtors and paupers, Savannah, in 1733.

The Swedes at Wilmington in 1638.

The Dutch at New York in 1613.

The Germans at Germantown in 1683.

Declaration of Independence, July 4, 1776.

Articles of Confederation adopted 1777.

Treaty of Peace between Great Britain and United States confirmed by Congress January, 1784.

Adoption of Constitution of United States in 1787.

Organization of Northwest Territory in 1787.

Louisiana Purchase in 1803.

War with Great Britain declared June, 1812.

Purchase of Florida in 1819.

Missouri Compromise in 1820.

Annexation of Texas in 1845.

War with Mexico, 1846.

Settlement of Boundary Question in Northwest, 1846.

Acquisition of New Mexico and California in 1848.

Discovery of gold in California in 1849.

Missouri Compromise of 1850.

Civil War, 1861 to 1865.

Emancipation Proclamation, Jan. 1, 1863.

Reconstruction Act, March 2, 1867.

Purchase of Alaska in 1867.

Annexation of Hawaii, July, 1898.

Spanish-American War in 1898.

Cession of Philippines and Porto Rico in 1898.

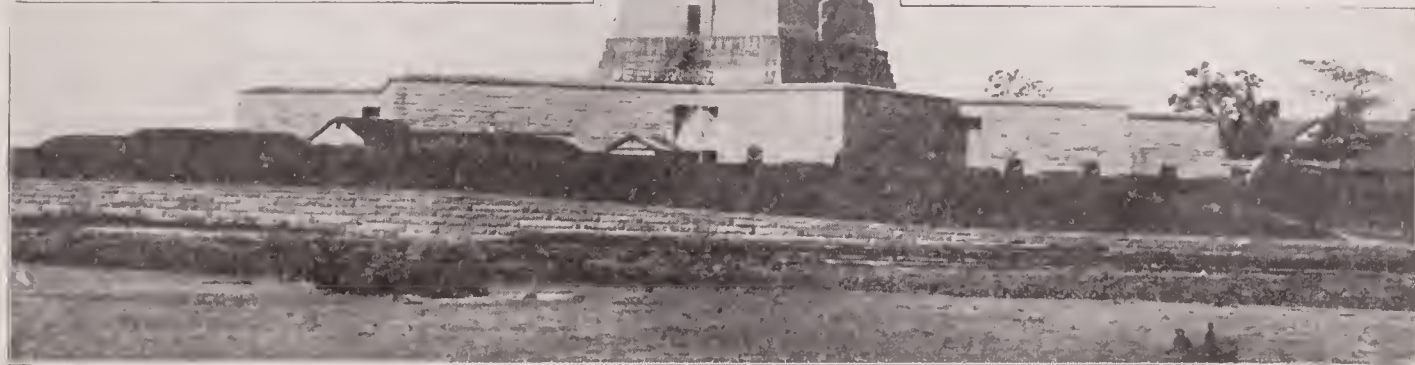
Philippine War begun Jan., 1899.



HOW IMMIGRANTS COME TO AMERICA

America, almost from the first days of the discovery of the continent, has been

recognized as the place of liberty for the oppressed of all other countries. The magic word liberty has appealed to millions of people the world over, who have sought our shores as immigrants to find a new home in a land of freedom. For many years few limitations were placed upon incoming strangers from foreign lands. But as their numbers increased and our public domain of unsettled lands diminished, it was realized that the wiser course was to limit the numbers and to improve the quality of im-



"LIBERTY ENLIGHTENING THE WORLD."

The Bartholdi Statue in New York Harbor, which greets Immigrants arriving in the United States from Europe.

migration where possible. Chinese immigration was altogether forbidden, and certain restrictions were adopted to safeguard the nation from improper European immigrants.

It must be admitted, however, that in spite of legislation forbidding the importation of laborers under contract and the exaction of certain standards of health, intelligence, and money from the immigrants seeking admission, the conditions have not greatly improved. The influx of immigrants from Hungary, Italy and Russia of late years, has been enormous, while there has been a gradual reduction in the numbers from Germany, Scandinavia and the British Isles, or the more desirable elements of population. Of course, it is to be expected that Hungarians, Italians and Russian Jews will develop into good American citizens at least in the second generation here, if not in the first. But they come to this country with but faint realization of the ideals and aspirations of Americans and little prepared for the liberty which rules here. They do not assimilate with the American and the Northern European elements of our population, nor do they scatter into the country, but, forming their own communities in our great cities, they help to add to the puzzling problems which face our students of municipal life.

The greatest number of immigrants reaching the shores of America enters by way of the port of New York. The first conspicuous object which greets them and for which they have been looking all the way across the Atlantic, for it is famed throughout Europe, is the great Bartholdi statue of "Liberty Enlightening the World," that splendid emblematic figure which rises from a little island in New York

harbor to welcome the stranger. Most of the immigrants know something of the significance of the statue and it rarely fails to impress them.

This famous statue was designed by Bartholdi, a great French sculptor, and was given to the people of the United States by the people of France. The site on Bedlo's Island was set aside for it by the United States government, and the pedestal was erected by funds given by contributors from all over the United States. The statue is made of thin sheets of copper beaten into shape and fastened about an iron skeleton. The figure of the statue itself is $110\frac{1}{2}$ feet high and weighs 100,000 pounds. The uplifted torch extends this height twenty-six feet more, and adding to this the pedestal, the tip of the torch is elevated 220 feet from the ground. The pedestal is of stone, eighty-two feet high. Some idea of the enormous proportions of the statue may be given from the fact that the forefinger is eight feet long and four feet in circumference at the second joint. The head is fourteen feet high, and forty persons can stand in it. The observation balcony around the torch, just below the flame, is a favorite viewpoint for travelers who wish to see the whole of New York City, with large portions of Long Island, the New Jersey coast, and New York harbor spread out before them in one splendid panorama.

Closely associated with the idea of liberty itself, is that splendid relic now considered our chief emblem of independence, the old Liberty Bell of Pennsylvania. The order for the bell was given in 1751. The State House of Pennsylvania, in Philadelphia, work on which had been suspended for a number of years, was then approach-



RUSSIAN IMMIGRANTS, "THE DOUKHOBARS."

ing completion. A committee was appointed to have a new bell cast for the building, and the contract was awarded to a London manufacturer, the specification being that the bell should weigh 2,000 pounds and cost £100.

In August, 1752, the bell arrived, but though in apparent good order, it was cracked by a stroke of the clapper while being tested. The bell was recast, and the new bell was found to be defective also. Once again there was a recasting of the metal, with the alloy of copper in a new proportion, and this third effort was a success.

It was on Monday, the 8th of July, 1776 (not the 4th), that the bell rang out the memorable message of liberty and signaled the promulgation of the Declaration of Independence. It seemed strikingly prophetic that the bell should have been cast with the motto, "Proclaim liberty throughout all the land, unto all the inhabitants thereof." For fifty years the bell continued to be rung on every festival and anniversary, until it eventually cracked in July, 1835, when it was tolling for the death of Chief Justice John Marshall.

Since that time the bell has been one of the chief attractions to Americans visiting Philadelphia, and its place in the State House has been a shrine for patriots. Of late years the bell has been a conspicuous attraction at the various great expositions held in the United States. Wherever it has been taken, to Chicago, Omaha, Nashville, Buffalo, Charleston or elsewhere, its journey has been a triumphal progress, and thousands of interested citizens have turned out along the way to watch its train in passing. Significant as it is, as a memorial of those colonial days when our fore-

fathers were struggling for independence, this Liberty Bell and the Statue of Liberty seem linked together through the century by a common significance.



IMMIGRATION STATISTICS

The latest statistics of immigrants into the United States from all the world since 1867 are given herewith. It is interesting to note the periods of fluctuation that mark the successive years. The increase from the end of the Civil War to the panic of 1873 was large and almost uninterrupted. Then came a rapid decrease, and until the return of striking prosperity in 1880, the numbers were comparatively small. The next few years showed enormous immigration, with 1882 as the highest water-mark. Again, however, there was a steady decrease for a few years, although the tide turned in 1887. When our last panic came, in 1893, it cut down immigration very rapidly, and since that time, coincident with a more exacting administration of the immigration laws, the numbers have never again approached their highest point, although since 1898 there has been an annual increase. The figures for the years indicated follow herewith. It should be understood that the calculations are made at the close of each fiscal year, which ends with June 30.

1867.....	298,967
1868.....	282,189
1869.....	352,569
1870.....	387,203
1871.....	321,350
1872.....	404,806
1873.....	459,803
1874.....	313,339
1875.....	227,498
1876.....	169,986
1877.....	141,857

1878.....	138,469
1879.....	177,826
1880.....	457,257
1881.....	669,431
1882.....	788,992
1883.....	603,322
1884.....	518,592
1885.....	395,346
1886.....	334,203
1887.....	490,109
1888.....	546,889
1889.....	444,427
1890.....	455,302
1891.....	360,319
1892.....	623,084
1893.....	502,917
1894.....	285,631
1895.....	258,536
1896.....	343,267
1897.....	230,832
1898.....	229,299
1899.....	311,715
1900.....	448,572
1901.....	487,918



OUR AMERICAN ARCHIVES AND NATIONAL INSTITUTIONS

That which might be known as the archive of American relics is the Smithsonian Institution or National Museum at Washington. It attained its present form when, in 1881, the building now occupied was completed for the national relics that had been transferred from the Centennial Exposition and the old buildings of the Smithsonian Institution. Although the relics of the Museum and the Institution are housed together, and are under the same management, they are separate organizations. So, with the ten million dollars given to the government by Andrew Carnegie for the establishment of a university of post-graduate scientific investigation, the three will be made to work together in harmony, which, with the nearness of the great

Congressional Library, and the many bureaus of the government, such as the Fish Commission, Geological, Coast, and Geodetic surveys, the Naval Observatory, and the Weather, Botanical, Biological and Entomological Bureaus, will together make the greatest post-graduate university in the world.

* * *

POPULATION AREAS OF THE UNITED STATES

America's "seat of empire" is found in the prairie region of the Central West, of which Chicago is the commercial metropolis. The flat or undulating prairie, in its natural state almost bare of trees, but covered with luxuriant grasses, now constitutes the topographic division of the United States which contains the greatest population. The prairie as the home of American citizens has outstripped all competitors. Neither the populous New England hills nor the great Atlantic coast plain, with its large cities and many thriving towns, nor yet the vast interior timbered region with all its wealth and opportunity, has kept pace with the beautiful prairie of the West.

According to the geographers of the census bureau, continental United States is divided into nineteen regions, each having somewhat uniform physiographic features. The population of these regions and their percentage of the whole population of the United States is as follows:

	Population.	Pct.
Prairie region.....	13,300,970	17.5
New England hills (includes New York City and a strip of eastern New York State, also the Adirondacks).....	10,260,153	13.5
Lake region.....	9,571,215	12.6
Interior timbered region.	8,129,760	10.7
Piedmont region.....	6,809,103	9.0
Coastal plain (east of Mississippi river)....	6,427,635	8.4
Allegheny plateau.....	6,070,246	8.0
Appalachian valley.....	4,499,072	5.9



POPULATION AREAS OF THE UNITED STATES.

Coastal plain (west of Mississippi river)....	1,974,677	2.6
Coast lowlands.....	1,865,952	2.4
Mississippi alluvial region	1,227,094	1.6
Ozark hills.....	1,203,880	1.6
Coast ranges.....	1,079,992	1.4
Great plains.....	1,052,719	1.4
Pacific valley.....	995,363	1.3
Rocky mountain.....	592,972	0.8
Great basin.....	375,345	0.5
Columbian mesas.....	356,758	0.5
Plateau region.....	201,669	0.3

It is the theory of scientific statisticians that geographic differences exert a profound

influence upon the people subject to them. They contend, therefore, that a division of the country into well-marked natural regions affords a better basis for classification of the population of the United States than the political lines often arbitrarily run. Nature, not man, fits a country for population, and the population will be great or small according to the advantages or disadvantages which nature herself has prescribed. Geology, topography, altitude, rainfall, temperature and soil—these are the determining factors. Thus dividing

the United States into natural rather than into political regions, it certainly is a noteworthy fact that at the beginning of the new century the prairie region stands first in the list.

More than one-sixth of the whole population of the continental United States lives upon the prairie. The people of the prairie equal one-third of the population of France. They are as many as the people of Germany, leaving out Prussia and Bavaria. They equal one-half of the population of England and Wales. They almost exactly duplicate, in number, the entire population of Mexico, and are but a little short of the total number in Spain. They outnumber the combined populations of Belgium and Holland.

Strictly speaking, Chicago is not itself in the prairie region. According to the geographers of the census, the great western metropolis stands within the lake region, a few miles from the line where the mighty prairies begin their stretch toward the west and south. This lake region is third in the list of great topographical divisions of the United States, and the two areas which lie on either side of Chicago contain together a population of nearly 23,000,000, or 30 per cent of the entire population of the United States. If to these two be added the interior timbered region lying near to Chicago on the southeast, and embracing most of Indiana, Ohio and Kentucky, and small parts of Illinois, Tennessee and Missouri, it will be found that the three regions adjacent and



TAXIDERMIST AT WORK.

tributary to Chicago comprise more than two-fifths of the people of the United States.

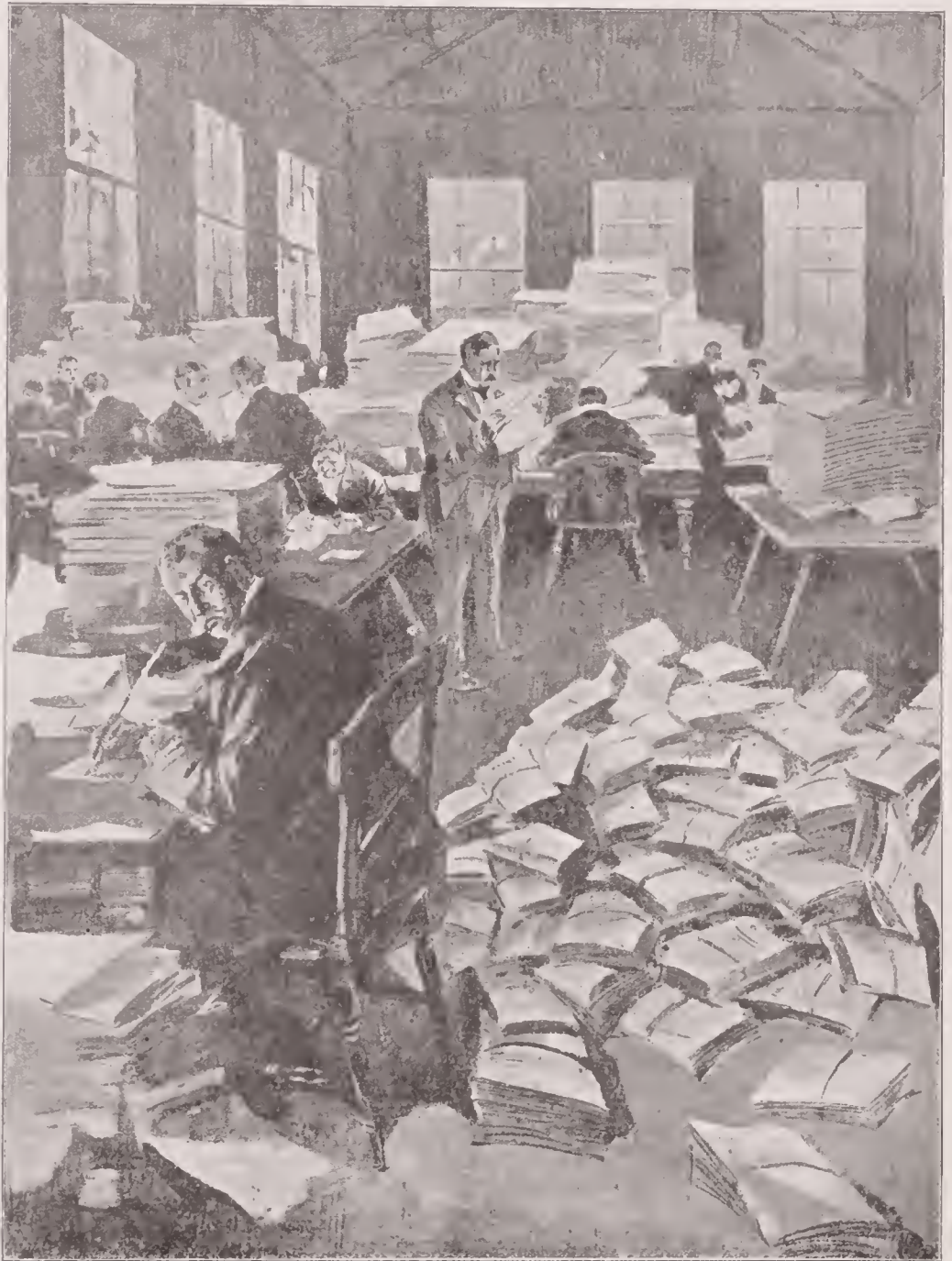
It is worthy of note that the second most populous topographical region, the New England hills, is the section which gave blood and bone and sinew and spirit to the prairie and the other areas of the farther West. The "star of empire" has taken its way from these hills to the timbered country beyond the mountains, to the borders of the great lakes, to the mighty prairie. There is a homogeneousness between the people of all four of these natural divisions of the continent which cannot be found between any other populous areas; and these four together furnish homes for 54 per cent of the people of the United States.



FACTS ABOUT OUR POSTAL SERVICE

Uncle Sam has many functions to perform in his capacity of governing a great country. With his army, he is a policeman; with his treasury department, he is a banker; with his agricultural department, he is a farmer; and with his mail service, he is a postman, to say nothing of a great many other functions of governing

which might be named. In his capacity as a postman, Uncle Sam's mail routes now include the delivery of letters to the Philippines, to the West Indies, and to Alaska, as well as all over the United States. Perhaps most difficult of all these mail routes,



AT WORK IN THE CENSUS BUREAU.

although not the longest, is that by which the miners and whalers in northernmost Alaska have their mail brought to them in winter. The Hudson's Bay Company for

more than 100 years has been maintaining communication through the trackless wastes of western and northern British America, from trading post to trading post, all the way from Hudson's Bay to the Mackenzie River, and far up into the Arctic Circle. But not until the discovery of gold in the hidden treasure houses of Alaska and the Canadian northwest, at Dawson City and Nome and points even more remote, did Uncle Sam's postmen have to assume such labor.

It was early in the spring of 1901 that the first carriers were sent to the farthest northern part of Alaska with the United States mail. Two men assumed the dangers of the journey a thousand miles over the ice fields, Francis H. Gambell and W. S. Flanagan. Their course was from St. Michaels to Kotzebue, returning by Cape Prince of Wales, Port Clarence, Teller, Nome, Golovin Bay and Norton Bay. They took with them but one sled, built of light birch and drawn by six Alaskan dogs. Their load included the mail, deer-skin sleeping-sacks, a shot-gun, snow-shoes, cooking utensils, a stove and other supplies, and their food itself, a total load of more than 350 pounds, which would, of course, be lessened day by day.

They started on a bright day with the thermometer four degrees below zero, but were not lucky enough to find it so warm all the way. Sometimes it was sixty degrees below zero, with a blizzard blowing, in which event they had to seek such shelter as they could get under the snow or otherwise. Sometimes they had to flounder through soft snow and pack down a trail with their snow-shoes, so that the dogs and sled would not sink down into it. At other times they had a glazed surface of ice or

snow-crust and under these conditions traveling was easier.

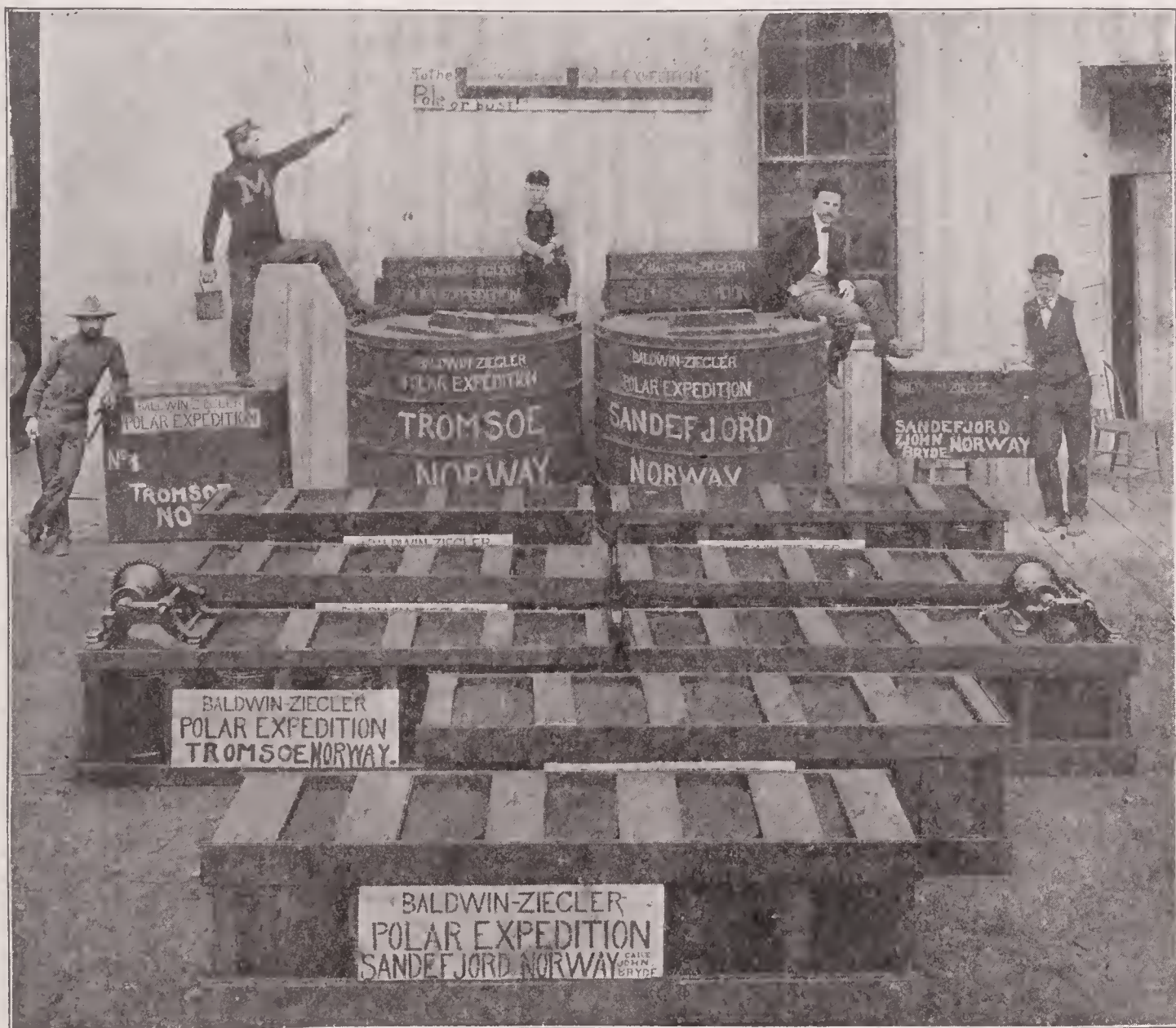
Although Alaska is by no means a settled country, still it is not as lonesome as it was a few years ago, before the rush to the gold fields began. So sometimes the weary, half-frozen postmen would come to a little hut half buried in the snow, inhabited by Eskimos in some cases and at other times entirely deserted. Whatever the shelter, it was welcome. Frozen ptarmigan could be bought from the Eskimos for dog food, and the warmth of the hut was always grateful. Sometimes it was absolutely impossible to have a warm meal, even in one of the deserted huts. Mr. Gambell tells of one evening when he fed the dogs on frozen salmon and frozen bacon and crawled into his sleeping sack, dressed as he had been on the trail, to eat his supper with his hood and mittens on. His tea got cold before he could drink it, the beans seemed never to have been warmed up, the fork froze to his lips, and the biscuits and doughnuts were so hard that he first cut them up with his ax, so that he might be able to eat them. But in the end his appetite was satisfied and he drew the fur hood of the warm sleeping-sack over him and retired to rest.

At one of the native villages where they were hospitably received and given shelter by the Eskimos, they found the air in the hut so empty of oxygen that a coal-oil stove would not burn. The room was heated with seal-oil lamps, and the heat from the bodies of the human beings and dogs. Before going to bed, the master of the house closed up the only opening. There were fourteen people and two young dogs in that one small room, while the odor from the seal-oil added to the stifling closeness of the air. A few days later the postmen reached

Nome, which was the last station on their great circuit, and there they found what seemed genuine civilization again, with town life going on after the American fashion, in spite of the remoteness of the place. The mails were coming in by way of Dawson City once a week, being carried 2,000 miles by dog-team, and only two months old from home. These are the most remote and the most difficult mail routes which Uncle Sam's postmen have to travel, and they offer another indication of the remarkable ramifications of the services which a great government performs for its citizens.

The United States postal service is the greatest of its kind in the world. It spends more money, employs more men, and interests more people than any other institution ever established. In round numbers there are 75,000 postoffices and 250,000 employees. It handles annually ten billion pieces of mail matter, of which three billion are letters. We spend on the service as much every five hours now as in an entire year of Washington's administration.

Nearly 25,000 letters a day go astray from careless addressing, and the valuables in them amount to more than a million dol-



CASES OF HIGHLY CONDENSED PROVISIONS, READY FOR SHIPMENT TO THE FAR NORTH.

lars a year. The auditing department is the largest accounting office in the world. Every cent is there accounted for and it requires more than five hundred clerks to do it.

This is regarded as the most efficient government service of such proportions in the world and would be profitable except for the thousands of tons of mail matter handled as second-class mail matter at one cent a pound. This includes all classes of serial publications, but by a ruling of the assistant postmaster general a vast quantity of this matter has been excluded, such as paper-covered books and so-called newspapers and magazines that secure their circulation, not by merit, but by the premiums given. The carriers and clerks of the post-office have longer hours of labor and more exacting work than any other extensive branch of the service.



PEARY AND THE NORTH POLE

The conquest of the far north has been the object of the energies of explorers for many a year, and more than one of the greatest names in geography have gained their fame in this field of discovery. In late years there has been no cessation of the effort to reach the North Pole, and no year passes without the departure of some conspicuous expedition on that quest. Franklin, Kane and Greeley have been followed by Andree, Nansen and Peary, whose names are to-day those best known in Arctic exploration, the first for his disastrous balloon journey from which no one has returned; the second for his achievement of the farthest north; and the third, our own American explorer, for his persistence in his campaign against the pole.

Year after year, Lieutenant Robert E.

Peary has renewed his assaults upon the land of ice and snow, each time accomplishing more in the discovery of important geographical and scientific facts, and each time coming nearer to the goal of his ambition. In this year of 1902 Lieutenant Peary is making his last attempt to reach the North Pole, for his wife has his promise that he will not go again. Already he has led four expeditions and has made seven voyages into the Arctic Seas. He has had his share of suffering and reverses, but unlike most polar explorers, who lose their enthusiasm after a voyage or two, he persists in the cause to which he has given the best years of his life.

A glimpse at the early history of Peary will help to indicate the character of the man who has fought so courageously for this prize. He was born in Pennsylvania in 1856, but passed his boyhood and youth in Maine, developing a love of outdoor life. He was educated at Bowdoin College, where he ranked high as a scholar and as an athlete. When he was twenty-three years old, he entered the service of the United States Government in the Coast and Geodetic Survey at Washington, and after two years passed examination and was appointed a civil engineer in the Navy Department. In the first year of his service he planned and built a new pier at Key West, Florida, which the contractors had given up as impossible of construction at the estimated cost, at a saving of nearly \$30,000 below the estimate. Next he was sent to Nicaragua as one of the chiefs of the canal survey and it was after that, when he returned to Washington in 1885, that the idea of Arctic exploration occurred to him.

He made his first journey to Greenland

in 1886, and then spent two years again on the survey of the Nicaragua Canal. In 1891 he prepared to discover the northern limits of Greenland, and obtaining some contributions from societies and friends, he added all his own savings and set sail northward. At the very beginning of the journey, his leg was broken by an accident on shipboard, but he refused to return home, and spending the winter in Greenland, the next spring he set off with a single companion. In forty days they covered over 600 miles, reaching on the 4th of July the northern end of Greenland, which no man ever had seen before.

By his indomitable energy Lieutenant Peary obtained the funds, equipment, and an additional leave of absence for another journey. His chief source of income was his remarkable lecture tour, which earned him \$13,000 in three months. In 1893 this expedition sailed, Mrs. Peary accompanying her husband to the far north. It was at these Greenland winter quarters that little Anighito, the "snow baby," was born to Lieutenant and Mrs. Peary. The next summer's journey into Greenland brought so many perils, hardships and disappointments that the explorer thought his Arctic work was finished. He soon discovered, however, that he could not be contented in comfort at home, while his plans for reaching the Pole were still untested. In 1896 and 1897 he made shorter voyages into the Arctic regions, and finally completed his plans for the extreme test.

By this time his untiring energy had won him a host of rich and influential friends at home, and they were making the preliminaries easy for him. Supplies, money and vessels were no longer out of reach, and in the summer of 1899 Peary

sailed to the north for the seventh time, where he has been ever since. The intervening winters have been devoted to preparing the way for his dash to the Pole. He has established supply stations of provisions at intervals all the way along Smith Sound, Kennedy Channel and Robeson Channel, to Cape Hecla, the place of departure across the ice of Lincoln Sea toward the Pole. Cape Sabine, where Peary camped for the winter of 1901 and 1902, is famed in Arctic exploration as the place where nearly all the members of the Greeley expedition perished by starvation and cold twenty years before.

The camp was within a mile of that disastrous camp from which the few survivors were rescued by Admiral Schley, then captain, as a result of his own indomitable bravery and energy.

The prospect of success before Lieutenant Peary comes from the fact that he has gained the most exhaustive experience that anyone has to-day in the field of Arctic exploration. In the Arctic he lives as an Eskimo and speaks as an Eskimo, knowing as well as they how to drive dog teams, throw harpoons, and subsist upon frozen walrus and seal meat. Taught by the experience of the past, he established these supply stations so that when he should leave the last one of them behind, to begin his hasty journey to the Pole, he would be but 500 miles distant from that goal. The announced plans for this dash indicated that the explorer would take with him a large number of dogs, a party of Eskimos, and as a companion, Matt Henson, his faithful body servant, who has been his companion for years.

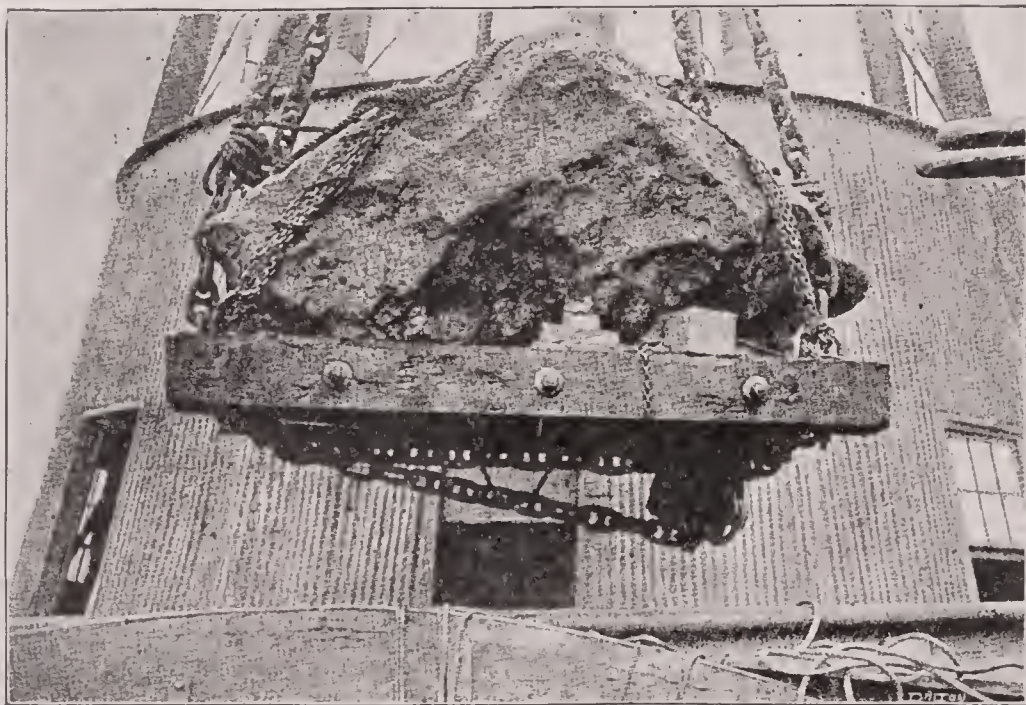
It was supposed that the distance to be passed between Cape Hecla and the Pole

would be found an untrodden waste of shifting ice with many channels of open water. As Peary advanced, he was to send back his Eskimos from time to time, until he, Matt Henson and one Eskimo were alone with the sledges and the dogs. Thus they would rush northward with the knowledge that they must reach the Pole and get back to solid land within three months, before the snow and ice of the Arctic Ocean should soften too much under the summer sun. As their food should give out, they would feed the weaker dogs to the other members of the team, so that before they would return they might have but one dog left to be their own final food supply.

Not until September, 1902, can word be received as to the success or failure of this important undertaking. The ship which is to bring the word back, will sail northward with Mrs. Peary to meet the explorer at Cape Sabine, and not until then will

the world know whether the Pole has been reached at last.

The people who know Peary best are the ones who have the greatest confidence that he will succeed. He was not conquered by a broken leg, the amputation of seven frozen toes, and the sinking of one of his ships with all on board, nor the succession of freezings, semi-starvation, and hardships that have faced him in the far north. He is untiring in his energy and endurance, and explaining his own purpose in these journeys, declared that he was after the Pole "because it is the Pole, because it has a value as a test of intelligence, persistence, endurance, determined will, and perhaps, courage, characteristic of the highest type of manhood; because I am confident that it can be reached, and because I regard it as a great prize which it is peculiarly fit and appropriate that an American should win."



THE GREAT PEARY METEORITE, WEIGHT 100 TONS.

THE REGION OF THE YUKON

"Never buy a pig in a poke," is the wise advice of our forefathers, and yet that is what the United States did when it gave, in 1867, seven and a half millions in gold and useless war-vessels to Russia for the territory known as Alaska. Neither party to the transaction had the least idea what the territory was worth. Yet the advice of the old saying was this time at fault, for Alaska has already returned more than the amount of its purchase price in the fur trade alone, with its other vast resources almost untouched.

The Yukon River is two-thirds the length

of the Mississippi, and drains a region a little more than one-third the size of the Mississippi Valley. In winter the water freezes to an average depth of five feet, but on the south side of the Yukon Basin, vegetation grows luxuriantly in the summer and cereals of the hardier kind may be made to yield bountiful harvests.

The discovery of gold has caused the heretofore unknown regions to be widely explored and there is every reason to believe that Alaska may support as prosperous a population as any of the Rocky Mountain States. Territorial laws have been



GOLD PROSPECTING IN THE YUKON COUNTRY.

extended over every settlement, schools and churches have followed, until frontier and Arctic hardships have almost wholly given way to the comforts of civilization.



GREAT FUR-TRADING COMPANIES OF CANADA

Far away from the strife of contending political parties, and little visited by outside affairs in the winter, sleeps under its coat of snow the vast kingdom of the fur-traders. Overhead is the dazzling bright-

ness of a northern sky, which at night is covered to the very zenith with dancing auroras. In summer, for two, three, or more months, the streams are unbound, a luxuriant vegetation bursts forth, and the summer green is as intense as the wintry whiteness has been.

Here the fur-trader must remain king. Mink and beaver, marten and otter, wolves, foxes and bears are his subjects, and, as in the case of all autocrats, the subjects exist for the profit of the ruler.

Perhaps one-quarter of North America

will always remain the fur-traders' preserve. If a line be drawn from Moose Factory, at the foot of Hudson's Bay, to Norway House, at the northern end of Lake Winnipeg, thence to Fort Resolution on the Great Slave Lake, and westward to the Stikeen River on the Pacific Ocean, the boundary of a region will be marked, to the north of which is the fur-traders' kingdom, which likewise includes the whole Labrador peninsula east of Hudson's Bay. It is true this fur-traders' line has for two centuries been moving northward. Time was when the region of the Great Lakes, from Ontario to Superior and Michigan, was the home of the trader. It was



TRAPPERS AT WORK IN THE FAR NORTH.

for the fur of this large area that the early governors of New France and New York plotted and fought. So, later on, Rupert's Land, as the Arctic region of the north was called, was kept by the Hudson's Bay Company closed under fur-trading conditions.

Through the opening up of this region by the Dominion of Canada, the fur-line was moved north four or five hundred miles. Perhaps from the physical condition of the country, as unsuited to agriculture and possessed of a severe climate, the region north of the line traced above may always remain undisturbed to the fur-trader. Of this, however, no one can speak certainly, for the same declaration was made of New York, then of Canada, and later still of Rupert's Land.

There is a strange fascination about the life of the fur-trader. Placed in charge of an inland fort, surrounded and ministered to by an inferior race, and the leader of a small band of employes, his decisions must be final, and his word taken as law. As a monarch of his solitude he has great responsibility. His supply of goods must be obtained. There are places in the Yukon region where, hardly more than a decade ago, nine years were required from the time goods left London, until news of their receipt reached the shippers in London. It required wisdom and foresight to manage a post so remote.

In the busy season scores of Indians, squaws, and children may be seen in groups seated on the ground in the midst of the fort, their encampment being a group of tents, bark or skin, outside the stockade.

Washington Irving, in 1818, described, in "Astoria," the picturesque and somewhat hilarious life of the fur-trader in the Nor'-wester capital of Montreal. Factors, trad-

ers, and voyageurs reveled in their liberty till the advance of the season compelled the voyage to be again undertaken. They sang at Ste. Anne, as they entered the Ottawa River, "their parting hymn," prayers were said to the patron saint of the voyageurs, the priest's blessing was received, and they hied away to face the rapid, décharge, or portage of their difficult route. When Fort William, on Thunder Bay, Lake Superior, was reached, they turned over their merchandise to new relays of men.

Scattered throughout the whole fur-trader's territory will be found the half-breed of French-Canadian or Orkney origin. Some beautiful lake or sheltered bend in the river, or the vicinity of a trader's post, has been selected by him as his home, and partly as an agriculturist or gardener, but far more a hunter or trapper, he rears his dusky race. Sometimes, when the engagé had served his score or two of years for the company, he retired with his Indian spouse and swarthy children to float down the streams to the older settlements, to what has been called "the paradise of Red River," and there, building his cabin on land allotted by the fur company, spent his remaining days.

Whatever may be said of its influence on the white man, the fur-trade has been a chief means in cementing the alliance between the white and red man. The half-breeds are a connecting link between the superior and the inferior race.

For many years it was the inflexible regulation of the Hudson's Bay Company to allow no half-breed to become an officer, but the rule could not be maintained, and on account of the Hudson's Bay Company having always assisted in the education and

Christianization of the native people, many of them have risen to high places in the fur-trade, as well as in other spheres of life.



THE WALLED CITY OF THE NORTH

"Quel bec!" (what a promontory) cried

The Latin nations of Europe have always been very fond of giving nick-names to places newly discovered, especially if derived from some first impression of the scene, so "Quel bec," became Quebec, and has so remained ever since. Quebec, because of its isolated position, has kept its ways with but little regard to the changes



ICE JAM ON THE ST. LAWRENCE RIVER AT MONTREAL.

a Norman captain as he stood on the deck of his vessel and looked at the great wall of rock which lined the bank of the St. Lawrence.

of modern civilization. It is the American Gibraltar, and, perhaps, could never have been taken by Wolfe if Montcalm had not heroically scorned to fight behind stone



CANADIAN BOATMEN IN THE RAPIDS OF THE ST. LAWRENCE RIVER.

walls. Montcalm is buried in the Ursuline Church founded in 1639.

It is noted for the ancient beauty and venerable architecture of its chapels and churches. Here French and English in peculiar harmony, considering racial prejudices and differences in customs, labor and live side by side. Modern conveniences and scientific improvements make slow progress here and it is of all American cities the most like those of Mediæval Europe. The religious customs of the people are everywhere most in evidence and are the first to impress the visitor who is accustomed to the free and easy cosmopolitan ways of life in the United States.



PILGRIMS AND SHRINES IN CANADA

The shrine at Varennes is distinguished by the possession of a miracle-working picture of Ste. Anne, that attracts great crowds of pilgrims. Varennes has been a place of pious resort since 1692, and a beautiful church stands there, from which every year

a solemn and stately procession, bearing the precious picture, sets forth, and, passing up and down the village street, makes glad the hearts of thousands assembled to do it honor. One other subsidiary place of pilgrimage is at the lovely little hamlet of l'Ange Gardien, just below the Falls of Montmorenci, where there is a consecrated shrine of Notre Dame de Lourdes, having a statue of Our Lady, before which a perpetually burning light serves to symbolize her unwearying intercession on behalf of those who put their trust in her.

But however deeply these shrines may be venerated, and however successful may be the prayers properly presented at them, they pale in interest before that of Ste. Anne de Beaupre, the oldest and most renowned of them all, known par excellence as la Grande Sainte Anne, because of the surpassing number and brilliance of the miracles that have been wrought thereat, or as la Bonne Sainte Anne, in token of the high place it holds in the affections of the people.

Ste. Anne de Beaupre is most pictur-

esquely situated on the northern bank of the St. Lawrence, a little more than twenty miles below Quebec. It does not seem to be very clear just how Petit Cap, that being the primitive name of the locality, came to be indicated as the spot that Ste. Anne would delight to honor by her special blessing. According to one legend, in the early days of the Canadian colony some Breton sailors, being overtaken by a terrible storm whilst ascending the river, made a vow to Ste. Anne that, if she would rescue them from their present peril, they would erect a chapel in her honor on the first spot where they touched land. Scarcely had they made their vow when the wind fell, the waves sank to rest, the heavens shone blue above them, and presently they were safe on shore at Petit Cap. In fulfillment of their promise, they built a little wooden chapel, which, being too close to the river-bank, speedily fell a victim to the floods, and was thereupon replaced by a more substantial and more wisely situated edifice of stone.

While the foundation was being laid, a dweller in la Cote de Beaupre, named Louis Guimont, for many years a sufferer from a disease in the loins that bent him double, inspired by a religious fervor that enabled him to rise superior to his sufferings, managed to place with his own hands three large stones upon the growing walls; and lo! the third stone had scarcely been adjusted to its own niche, when there passed through the pain-racked toiler a strange feeling of exaltation and strength; and standing erect for the first time in many years he shouted aloud in wonder and joy at the miracle that had been wrought. The report of this marvel quickly spread. All the little world of that primitive community fell to talking about it, and among

those to whom it brought a mighty hope was Marie-Esther Ramage, the wife of Elie Godin. She, poor soul, had been bowed down for a long time under an affliction that compelled her to drag herself painfully along by dint of crutches, and seemed beyond the power of human aid to alleviate. Hearing from her husband of how Louis Guimont had been blessed, she determined to seek relief from the same source. Forthwith she repaired to the holy spot and invoked Ste. Anne's intercession on her behalf. Her prayer was granted. Her infirmities departed from her, and she went back to her home rejoicing.

These miracles were followed by many others, not less remarkable, whose reputation, spreading abroad, ere long made the little stone chapel the most celebrated place of pilgrimage in Canada.

Twelve years after the erection of the church it became the treasury of one of the most precious relics the Catholic Church in Canada possesses; namely, a part of the bone of one finger of Sainte Anne herself. Sent in 1668 to Bishop Laval by the Chapter at Carcassone, it was confided to the care of Henri Nouvel, one of the Jesuit missionaries in New France, and first solemnly exhibited to the adoring congregations in the Chapel of Ste. Anne de Beaupre on the 12th March, 1670. The history of this inestimable treasure is thus told by Abbe Casgrain:

"During the reign of Marcus Aurelius the infidels invaded the Holy Land and destroyed all the monuments, public or private, together with the coffins they entombed. One coffin, however, escaped this sacrilegious treatment. The infidel iconoclasts could neither break it open nor harm it; and in their rage they cast it into the

sea. But, strange to say, although of a prodigious weight, the coffin, instead of sinking to the bottom, floated lightly upon the waves until it found a resting-place in the sands near the town of Apt, in Provence. Here it lay hidden for a long time. One day some fishermen from the town caught in their net a fish so large that they had to disembark in order to drag it to land. When they had, after tremendous efforts, got the monster on shore, he took to leaping and throwing himself about with such energy and purpose as to dig a deep hole in the beach, and thereby bring to light the buried coffin. Forthwith the people gathered and sought to open it, but again it defied all efforts, and accordingly was, by the bishop's direction, deposited in a crypt which was then walled up, a burning lamp having first been placed inside.

"The centuries slipped away uneventfully until Charlemagne came to Apt as conqueror of Provence. He took up his quarters with the Baron Cazeneuve, who had a son deaf and dumb from his birth. Charlemagne, no less renowned for his Christian faith than for his martial prowess, ordered a purification of the church, which had, through the neglect of the people, become the abode of the owls and the bats. On the day appointed, all Provence assembled for the ceremony. In the very midst of the solemnities the deaf-mute, forcing his way through the throng, indicated to Charlemagne, by eager gesticulations, that he should cause a certain ancient wall to be torn down. Charlemagne not only gave orders accordingly, but with his kingly hands assisted in the work. The long-forgotten crypt was opened, and there, still burning brightly, stood the lamp lit many centuries before. The first to enter

the crypt was young Cazeneuve, and scarcely had he set foot within it, when he cried with a loud voice that filled the whole neighborhood: 'In this sacred place reposes the body of the thriceglorious Anne, mother of the Virgin Mary.' The king, accompanied by the archbishop, then went down into the crypt, and after having made obeisance, opened the coffin without any difficulty, finding therein a perfect body with this inscription: 'This is the body of Sainte Anne, mother of the Virgin Mary.'"



NORTH AMERICAN TOTEMISM

What is a Totem? Broadly, the badge of a clan or tribe, but something signifying a great deal more than mere political or social alliance. It is not only a tribal emblem, but also a family signal; not merely a symbol of nationality, but also an expression of religion; not simply a bond of union among primitive peoples, but also a regulator of the marriage laws and of other social institutions. A totem is a "class of material objects which a savage regards with superstitious respect, believing that there exists between him and every member of the class an intimate and altogether special relation."

The use of totems seems to have been first noticed among the North American Indians, and the word itself is an Indian one. In the Ojibway tribe there are no fewer than twenty-three different totems, or clan divisions. Nine of these are quadrupeds, marking out the wolf, the bear, the beaver and other clans; eight are birds, five are fishes, and one is the snake. In other words, the members of the tribe who carry these devices by so doing mark themselves as belonging to a distinct division of it, to be, for all time and for certain practical

purposes distinguished and separated from the other divisions.

It is easy enough with totems of this character to imagine a basis of worship as the origin of the tribal badge, but it is not easy to see the meaning in other cases. For instance, the totems of some of the other Indian tribes are such things as corn, potato, tobacco-plant, and reed-grass; as medicine, tent, lodge, bonnet, leggings, and knife; as sun, earth, sand, salt, sea, snow, ice, water, and rain; as thunder, wind, and even as "many seasons."

Next to the North American Indians, the aboriginal tribes of Australia present the

uela, Guiana and Patagonia; and traces also have been supposed among the aborigines (not the Incas) of Peru. In Australia it is universal,—we speak, of course, always of aboriginal peoples,—and in Africa it appears to be general in the south and west, and on the equator. It is found alike in Bengal and in Siberia, in Polynesia and in China.

In Samoa it is said that if a Turtle-man ate of a turtle he grew very ill, and the voice of the turtle was heard in his inside, saying: "He ate me. I am killing him." If a Prickly-sea-urchin-man consumed one of these shell-fish, a prickly sea-urchin grew in his body and killed him. If a Mullet-man ate a mullet, he squinted. If a Cockle-man carried away a cockle, it appeared on some part of his person; and if he ate it, it grew on his nose. If a Banana-man used a banana leaf for a cap, he became bald. If a Butterfly-man caught a butterfly, it struck him dead. If a Fowl-man ate a fowl, delirium and death resulted. And so on, all going to show that among some totem peo-



TOTEM-POLES IN AN ALASKAN VILLAGE.

most developed form of totemism of any peoples of our time. Among the Australians is to be found the same use of totems as among the Indians, and chiefly taken from the animal kingdom.

In Central America it is found among some of the tribes of Panama; and in South America it is found in Colombia, Venez-

ples, if not among all, the totem has something of the quality of a fetich, as well as the significance of a family emblem.

Totemism has reached the most extensive development and use among the aborigines of Alaska and British Columbia. There they live in totem houses and every act is regulated by totem superstitions.

BERMUDA, THE ISLAND OF LILIES AND ONIONS

Easter lilies and succulent onions and potatoes together reach perfection in the Bermudas. Many thousand boxes of lilies, ready for Easter services in the cities, reach New York in the early spring and in the early autumn. Many hundred thousands of bulbs reach the same port for the green-houses of the cities in winter.

Almost the entire export product of the soil in the Bermudas is lilies, onions and potatoes. In November and December the lily bulbs are planted in long rows, close to-

gether, and they grow slowly all winter. Early in March the shipment begins and during the month steamer after steamer is loaded with these delightful creations of nature. The stalks are cut low, retaining the buds and blossoms, and they are packed in light wooden boxes. They are sent to Hamilton, the chief town of the islands, whence the vessel takes them to New York in a voyage of about three days.

If a deep row of lilies about the altar of a church appears beautiful, it can be real-



BERMUDA LILIES—PART OF A FIELD OF THIRTY ACRES.

ized how superb is a vast field of these flowers set, as it were, in a frame of dark cedar trees. The lover of the delicate and beautiful can not look on such a glorious picture without a thrill of emotion.

The earliest potatoes to reach the cities of the United States come from the Bermudas, and with the three products, lilies, onions and potatoes, the scant forty square miles of territory in this group of nearly 400 islands is thus the year around almost wholly occupied.

The first discoverer, in 1522, was a Spaniard named Bermudez, whence the name. George Somers, an Englishman, was wrecked there in 1609 and there has been an unsuccessful effort made by English geographers to cause the group to be generally known as Somer's Isles.



NEGRO LIFE IN THE BAHAMAS

The reliance on the powers of the bush doctor or "obeah-man" is almost universal among the black people in the Bahamas, who greatly prefer him to the authorized practitioner. In some cases the remedies prescribed are simple, if not efficacious. A dose of sea-water is considered beneficial for a broken arm, and to hold salt in both hands is reckoned a certain remedy for various of the ills to which flesh is liable, and is also held to be of use in warding off ghostly enemies in the shape of evil spirits. Singularly enough, the same shield is used against the powers of darkness by peasants in the west of Ireland.

It is common when the bush doctor is consulted, for him to pronounce that the patient is suffering from an ailment caused by the presence of a beetle or a spider in one of the limbs. The doctor proceeds to

extract the intruder, by sucking the afflicted limb, producing the creature from his mouth at the end of the operation, in proof of its efficacy. Spools of cotton, buttons, nails, and so forth are sometimes "extracted" in a similar fashion.

In his character as wizard, the obeah-man is in request to guard the crops of pineapples or oranges from the hands of the spoiler, the ships from storms and shipwreck, and the crew from death and disaster. Not a schooner leaves the port but has a bit of obeah attached for good luck to the mast, while beneath their shirts a string of charmed twine preserves the men from danger by land or water. Vacant houses are also protected from intruders during the owner's absence by the obeah-man. To effect this police duty, a bar is rolled up containing a few rusty old nails and some pieces of rushes, and laid on the threshold of the cabin; on seeing this mysterious ball, no negro dares to enter the house unlawfully. A rudely carved head, fastened on a tree, is a secure guardian for a cocoanut or orange grove, while a horn with a cork on it stuck full of pins and a bottle of water underneath, is a favorite protection against thieves or spirits. It would be a bold evil spirit who would enter the field so guarded; he knows right well that the pins would prick him and force him to enter the bottle of water; no negro would dream of intruding within an enclosure where such a bottle was displayed. When the obeah-man's charges are high, or faith is weak, occasionally the owner of a farm throws himself on the good feeling of depredators. Visitors may sometimes see a placard fixed to a post in a field of maize on which is painted the polite request, "If you steal the corn, do please leave the blades."

Though the obeah-man is usually resorted to by owners who may have been robbed of their goods, any one in authority may be appealed to on an emergency when no clue can be had to the delinquent. The following paper was one day sent to the governor's secretary:

"Mr. Secretary: Will you please have the person arrested who stole my clothes? This is the prayer of your humble servant, John Smith."

When free from physical pain and not immediately pressed by his creditors, of whom he has in general many, the darkey is full of enjoyment of life, and there is much in life for him to enjoy. What would be the object of wasting existence in wearisome toil or monotonous drudgery, in a delicious climate where a cotton garment is ample for comfort, and sufficient money can be obtained by a few weeks' "sponging" to supply frock-coat, chimney pot hat and umbrella for a man on high days and holidays; while a week or two spent in digging holes in which to plant maize—a labor that the little Congo gardeners decline to perform, on the grounds of its being especially the work of "femilly wimmany"—or in

weeding the pine-fields, will procure for the women the wherewithal to purchase ostrich-feathers, white or colored satin boots, muslins and laces for festive occasions, amongst which funerals and attendance at divine service are not the least popular.

At a church a little distance out of Kingston in Jamaica, another island of the West



GATHERING BANANAS IN JAMAICA.

Indies, the clergyman proposed to shorten the afternoon service so as to enable the congregation to take advantage of a street railway car that passed the church in re-

turning to the city. On hearing of the threatened change a black man remonstrated with the rector. "Indeed, sir," he urged, "our ladies will nebber tink it worth while to dress merely to sit in church for one hour!" It must be observed that in the West Indies negresses are almost invariably spoken of as "ladies." At first it sounds peculiar to hear, "Missus, dere's a lady at de back door wants you to gib her a pair of old boots," or "Dat lady hab basket of eggs to sell," but one quickly gets used to it.

In speaking of "going for a few weeks' sponging" it must not be supposed that unsophisticated darkies resort to the civilized method of extortion known in colloquial United States as "sponging." In the Bahamas the term is applied to a cruise undertaken for the purpose of fishing up sponges from the banks of coral sand which extend for great distances in the archipelago. The water on these banks averages only three fathoms. On this submarine Sahara, the black, leathery, roundish lumps which, after undergoing much tribulation, eventually develop into the inviting-looking adjunct to the morning bath, have settled down, after their brief but erratic youth, to sedate repose in the crystal waters, till snatched from their retreat by the penetrating hook of the sponger.

Very unsightly and evil-smelling objects the sponges are when first torn from their native element, a sulphur stream or steeping flax being hardly more obnoxious to the olfactory nerve. Sponging has all the attractions of a gambling adventure. Should the cruise be successful, the profits are large and enough money may be made in a short time to ensure the enjoyment of months of idleness. And idleness is a real luxury when a man can recline under the

shade of his own guava or orange tree, and have the latest news from the passing neighbors as they saunter along, their fanners (round flat baskets of palm leaves) piled with glowing tomatoes, large green avocado pears, or red and yellow peppers, for sale in town—or else chew sugarcane or smoke a pipe as the spirit moves him, taking no thought for the morrow, which is pretty sure to be sunny and balmy as today.

Dwellers in the dark and sombre north can hardly realize the charm and joyousness that seem to radiate from earth and air in the lotus-eating southern climes. The mere sense of existence becomes in itself a happiness; one can understand what animals probably feel in pleasant pastures on brilliant days. Then, as the sun sinks slowly downwards, the golden heaven glows over a rejoicing earth, flashing every moment into richer beauty beneath the departing rays, while rosy beams of light streaming upwards like so many auroras are a singular and very beautiful effect often to be seen in a Bahama sunset. When the sun has set new beauties appear, every bush and tussock becoming alive with thousands of fireflies; and when a silvery green moon rises in the calm deep sapphire sky, it is difficult to decide whether night or day be the more full of loveliness.



CUBA'S FIRST PRESIDENT

Cuba has gone far enough on its way toward independence to elect and inaugurate the first president of the Island Republic. The Cuban who will enter history with this noteworthy distinction is General Tomas Estrada Palma, whose name has been prominent in all the Cubans' strug-

gles for freedom for many years. Of course, there have been provisional officials of Cuba during the periods of insurrection, but these organizations were only temporary, and were not calculated for any time except the period of warfare against Spain. Gomez, Maceo, Cisneros and Garcia are proud names in the history of the Cuban struggle for liberty, but the name of Palma must stand with them as that of a great man and a noble patriot.

General Palma was born in Cuba and was educated to be a lawyer. When the Ten Years' War against Spain broke out, his father, who was a rich planter in the province of Santiago, suffered many abuses and penalties for his support of the Cuban cause. His property was destroyed or confiscated by the Spanish, and his wife was killed. Young Palma went into the patriotic army and soon rose to a high rank in the insurgent forces. He was finally chosen president of the provisional government of the island. He was captured after nine years of fighting and was taken as a prisoner to Spain. He remained in captivity, because he refused to swear allegiance to Spain as the price of freedom, but after the end of the insurrection, he was released and came to the United States. For a time General Palma lived in Honduras, where he held important positions under the government, and married the daughter of the president of that Central American Republic. Returning to the United States he made his home in the village of Central Valley, New York, where he kept a school for Cuban boys whose parents desired them to have a genuine American education. At the time he was elected president, General Palma had not been in Cuba for twenty years.

At the outbreak of the Cuban Insurrection, which ended in the freedom of the island, General Palma became the head of the Cuban Junta in New York, and directed the organized support and assistance to his struggling countrymen. His energetic service against Spain brought him the worthy reward of being the first president of the Cuban Republic. General Palma is



TOMAS ESTRADA PALMA, CUBA'S FIRST
PRESIDENT.

sixty-six years old, a man of education and thoughtfulness, conservative in his judgments, and admired alike by Cubans and Americans. His expressions after his election were such as to increase the confidence in which he was generally held. He defined his policy toward the United States as follows:

"The principal object of the Cuban Re-

public should be first to secure the most friendly relations with the American people who helped us in our hour of need. We will always bear in mind the work of the United States in helping us to obtain our independence from the Spanish rule. At the same time we should try to secure from the Washington government all advantages possible for our products by reasonable reduction of the important duties, especially on sugar and tobacco, as this is the only way for Cuba to escape the absolute ruin of these two industries which are the bases of its actual wealth."

The Cuban election did not develop much opposition to General Palma, as General Maso, the opposing candidate, had withdrawn. There were, however, some partisan

expressions of dissatisfaction. It was charged by his political enemies that General Palma was the American candidate. It is impossible to believe, however, that he would at any time hold the interests of his own country as second to those of the great republic of the north. It may be assumed that he will be as patriotic a president of Cuba as he has been a citizen in working for the island's interests. At the same time he has the most friendly feeling toward the United States, from his knowledge of American conditions, gained by nearly twenty years' residence in this country. The vice-president of the Cuban Republic, elected at the same time with him, is Doctor Luis Estenez, once secretary of justice in General Wood's cabinet.



A COUNTRY HOMESTEAD IN CUBA.

SANTO DOMINGO—THE BONES OF COLUMBUS

Christopher Columbus, the discoverer of America, was born in Genoa, Italy, about the year 1435, A. D., and died at Valladolid, Spain, in profound obscurity, May 20, 1506. His body was deposited in a vault in the Convent Church of the Franciscans, where it remained for some time; but afterwards, according to a request made in his will, his remains were removed to the city of Santo Domingo in his "beloved Hispaniola," and placed in a small, enclosed vault in the cathedral. Just to the right of this vault were deposited the remains of Don Diego, the son of Columbus, who died at Montalban, in 1526; and long afterwards the bones of Don Luis, the grandson of Columbus, were brought to the same place. Thus there were three crypts in the Cathedral of Santo Domingo, one containing the remains of Christopher Columbus, one those of Diego, and the third those of Luis.

With regard to all these remains, the obscurity seems to have been profound until the year 1783. It was known to students of local history, that the remains of Christopher Columbus were somewhere in the building; but even the traditions as to his son and grandson were lost, or at least very vague. In that year, while making some slight repairs and alterations, a crypt was

unexpectedly found, and in it a small metallic case, without any inscription, which was at once accepted as containing the remains of Christopher Columbus.

In the year 1796 the war between France and Spain was brought to a close, and the Spaniards were compelled to cede to the French all the Spanish part of the island of Santo Domingo; but by the courtesy of the French officials they were allowed to con-



THE CUBAN FARMER.

vey the supposed remains of Columbus to Havana, and the exhumation was solemnly made on the 20th day of December, 1795.

On the 14th of May, 1877, the crypt containing the remains of Don Luis was accidentally discovered. This discovery caused much excitement, and revived an old tradition, that the bones removed in 1795 were not those of Christopher Columbus. The authorities now decided to make a careful investigation, which should verify, or else forever set at rest, the tradi-

tion. Their efforts were crowned with success. On the gospel side of the chapel (the left facing the altar) they found two crypts, the first one empty, because the remains had been carried away in 1795; the second one contained a small metallic case, with inscriptions in Spanish on both the outside and inside of the cover—"Most illustrious and renowned personage, Don Cristoval Colon," and "Discoverer of America, First Admiral." The chest was opened, only to increase the certainty; on the interior of the cover were found the words, "Most illustrious and renowned personage, Don Cristoval Colon."

On the two sides, and on the front, were the letters C. C., A., meaning Christopher Columbus, Admiral. Upon careful examination of the contents, there were found bones and bone-dust, very few and small, with a small bit of the skull, a leaden ball, and a small silver plate inscribed "U. Cristoval Colon."

Dr. Coppee says in his article on this subject in Stoddart's Review, from which this is mainly taken:

"Every one who was present at once accepted this ocular proof, that what was left of the body of the great discoverer had not been taken away to Havana, but was really there before his eyes, with an indubitable record of identification. It may be doubted whether in the wildest scenes of internecine strife and blood in all its history, Santo Domingo had ever witnessed such popular excitement. Time had brought them the knowledge of a great treasure. *Te Deums* were sung. The Legislature at once made an appropriation from 'the extraordinary funds' of ten thousand dollars as a contribution to a fitting monument. The archbishop, Roque Cocchin, kept his secretaries

busy in sending the news of the discovery everywhere. . . .

"When the news reached the Spanish capital, it struck everybody, court and people alike, with painful surprise. The honor of Spain was supposed to be impugned. It was not only humiliating in itself, but it argued great carelessness in the Spanish officials, at the time of the translation, that for more than seventy years they should have fixed upon Spain the delusion that the precious remains of the great discoverer were resting in the Cathedral of Havana, and that generations of reverential visitors to 'the pilgrim shrine' had been wasting their sentiment on a mistaken object.

"The letter of the archbishop, with the accompanying proofs, was placed, by order of the king, in the hands of the most appropriate body, La Real Academia de la Historia. A special committee was appointed to take the matter in hand. Of course they reported adversely, charging the Santo Domingans with schemes and fraud, and absurd credulity.

"The controversy that ensued brought out a work of three hundred and thirty-seven pages from the hand of the archbishop. In this valuable work he goes over much historical matter not before generally known. An unprejudiced perusal dissipates every shadow of art or deception. Few things are so clearly proven, as that the remains of the great discoverer are still preserved in the Cathedral Church of Santo Domingo, the spot which he selected as his burial-place. It has been proposed to erect a lofty column over the sacred dust, which shall tell the passing ships of every nation of 'the gratitude of mankind to Christopher Columbus.'"

VOODOO WORSHIP IN HAITI

Voodooism is the "black art" of uncivilized negroes. Some of its more harmless forms exist wherever there are large communities of black people, and many of its charms and incantations are used even among the superstitious whites.

Back in the dark forests of savage Haiti, it reached its greatest power a few years ago, and a small contribution to a bush doctor would cause the restoration of anything stolen by a negro anywhere on the island. The doctor would not seek the culprit but would merely let it be known that a charm had been sold to the man who had been robbed.

The stories of the voodoo rites are inde-

scribably horrible, and it has never yet been satisfactorily proven that they are all true. This much is known. Their special ceremonies and incantations take place in some secluded part of the forest where rocks or ravines make a natural barrier to observers. The devotees gather in a small circle around a basket containing the divine snake, which imparts any desired wisdom or knowledge to the priest or priestess in charge. Dancing about this circle by moonlight until exhausted, the votaries sit down and wait silently till the priest or priestess, who continues the dance, falls into convulsions, ending in a trance, during which the snake reveals the truth of any secret desired. After this the debauch of worship



THE HORRIBLE CEREMONIES OF VODOOISM.

begins and with it the orgies of blood and cannibalism, if such be true, as several alleged witnesses have asserted.

Other forms of Voodoo worship are carried on in the towns by the witch doctors, and the superstitious, though not indulging in any of the worship, supply themselves with charms and observe the various means of warding off the work of evil spirits.

The word Voodoo comes from the word Vandois, the name given to the followers of Peter Valdo, who founded the sect Valdenses or Waldenses of Piedmont. The historical massacre of these Christians in 1655 is remembered in Milton's sonnet,
 "Avenge, O Lord, Thy slaughtered saints,
 whose bones
 Lie scattered on the Alpine mountains
 cold."

The most horrible stories of cannibalism were told of these Christians and the French emigrants to Haiti gave the name Vandois to the cannibalistic rites of the negroes. In Switzerland Voudai is the name given to a wild and monster huntsman, who is a sorcerer, voudai signifying sorcerer. In some parts of Haiti and Louisiana, Voodoo is the name of a Satanic personage who is given homage in a form of devil worship, and he in return gives special powers to those who sell themselves to his service.

It may be interesting to mention that from a source pretending to much more depth of learning comes the assertion that this widespread practice and worship derives its name from the Ewe language spoken on the west coast of Africa, in which vo means "fear of" and du means "a god."

It is claimed that large numbers of the Ewe Africans were sold to the slave traders by a conquering king and carried to Haiti. The reason given to explain why the rest of

West Indies were so long free from Voodooism is that the English and Dutch took their slaves from the Gold Coast of Africa, where Voodoo worship was unknown. Also the introduction of Voodooism into Louisiana is accounted for from the importation by the French and Spaniards of slaves from Haiti.

The present condition of Voodooism in the West Indies is such that, if practiced at all in any of its barbarous rites, it is done with the utmost secrecy and official investigation has been unable to unearth it.



THE COCOANUT AND ITS USES.

Someone has aptly called the cocoanut palm the giraffe of trees, and beyond question there is a suggestion of that animal in the slender, curving trunk, with its feather-duster-like top of clustering branches and nuts. Found all the way around the world, in the tropical island and coast regions of Asia, Africa, South America, Australia, the Atlantic, Pacific and Indian Oceans, it is a wonderful tree of very great value.

In its natural state, the nut furnishes refreshing and nourishing food and drink. From the fiber of the thick, outer husk, cordage and cocoanut matting are made. The outer shell of the nut itself, and the wood are used for fuel in native dwellings, for which the leaves furnish a thatch, and the matting for walls, partitions and carpets. Thus every part of the remarkable tree is utilized.

The most valuable commercial products come from the meat of the nut. In some countries it is ground and pressed to extract the oil, and elsewhere the nut meats are permitted to dry in the sun, and then, as "copra," are shipped to Europe or America to be made into soap, cosmetics and toilet preparations.

PORTO RICO AND ITS CHARACTERISTICS

The United States ended its war with Spain, with the Island of Porto Rico and the little islands adjacent to it undeniably American possessions. There was no suggestion on the part of the people of Porto Rico that they should be left to form a republic of their own, as was planned for Cuba, nor did they oppose American rule as the Filipinos were doing. It has been necessary, therefore, only for the United States to establish a local island government under American guidance, and this has been done. The island, with its population approaching 1,000,000, is the most thickly settled of the larger islands of the West Indies. It was discovered by Columbus on his second voyage in 1493, and its largest city, Ponce, bears the name of one of its first governors, Ponce de Leon, the famous Spanish explorer, discoverer and undefeated conqueror.

When General Miles landed on the island with the American forces in 1898, he was welcomed joyfully by the people, who were glad to know that they were about to pass under the rule of the great American republic. Since that time there have been some political differences as to the policies of this government in its control of Porto

Rico but these difficulties have been eliminated and the people today are prosperous and contented. The island is exceptionally salubrious and it has never been afflicted with epidemics such as have been common in Cuba. It has another point of exceptional interest in the fact that it is the "whitest" of the Antilles. It is the only



HUSKING COCOANUTS ON A WEST INDIAN PLANTATION.

one of the West Indian islands in which the negroes are outnumbered by the whites, who comprise nearly 600,000 of the total population.

The resources are by no means fully developed, although the production of coffee, sugar, and tobacco is a considerable industry. Besides these staples, the island abounds in other tropical products, some of

which but wait the investments of American capital and American energy to become highly profitable. Under American rule education is being fostered and the cleanliness of the island is being maintained to the manifest advantage of health conditions. San Juan, the capital, on the north coast of the island, is a clean and picturesque West Indian city, particularly interesting to American visitors for the historic associations that center around its old Spanish fortifications and public buildings. It was founded in 1511 by Ponce de Leon. With its richness of resources, its beauty of scenery, and its charm of climate, Porto Rico is sure to become a favored island among the newly acquired possessions of the United States.

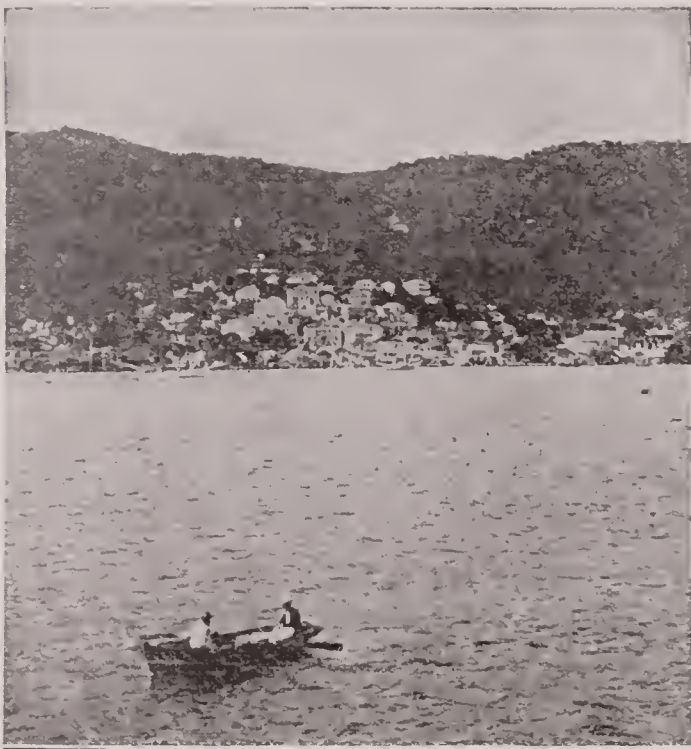
The Spaniard for many centuries had everything his own way in Porto Rico and therefore in every respect the Americans found it to be thoroughly Spanish. The streets of the towns are often so narrow that two wagons pass with difficulty and the



WOMEN CARRYING BANANAS FROM THE FIELDS.

sidewalks are sometimes too narrow for two persons to walk comfortably abreast. The gloom is increased by the balconies that project from the second stories, where on evenings the families sit and talk across to one another. Ponce, with its close adjoining villages, has 50,000 inhabitants, although there are not more than one-third that number in the town proper. The seaport of Ponce is two miles away at La Playa which has about 4,000 inhabitants. Mayaguez has 12,000 inhabitants and is the place where Columbus first landed on the island. They have a monument to commemorate the fact.

The introduction of American capital and American methods is rapidly developing the tropical resources of the island and changing the customs of the people. Railways are being improved and extended, new steamship lines are plying between New York and San Juan, new hotels and stores are being established. But nothing can change the beauty of the island.



VIEW OF HARBOR AND TOWN OF CHARLOTTE AMALIA, ST. THOMAS.

SAINT HELENA, THE ISLAND OF EXILES

A little more than a third of the way from Africa to South America is an island containing 47 square miles which first became famous as the last prison of Napoleon and has again been brought into note as the place of exile for prisoners from the Boer war in the Transvaal. This isolated island was discovered on St. Helena's day, 1501, by the Portuguese. The discovery was kept secret and it was taken possession of by the Dutch, who abandoned it in 1651 to establish their colony at Good Hope. It was then occupied by the English, and was taken and retaken several times by Dutch and English till 1672, when the English became its permanent possessors by fortifying it.

At a distance it looks like a pyramid rising from the sea, but on a near approach it is seen to be surrounded by rock bluffs rising in sheer precipices from the sea to the height of a thousand feet. In the center

Mount Diana is 2,700 feet above the sea. Being of volcanic origin, there are but few valleys where vegetation is luxuriant. As the island cannot more than supply the simple wants of the few inhabitants, its only commerce is in supplying vegetables to passing ships. It is an ideal place for the complete isolation of political exiles.



DANISH WEST INDIES

St. Thomas is six miles from St. John and forty miles from St. Croix. Their combined area is less than 140 square miles. Of the 35,000 inhabitants, about one in seven is white. Sugar and rum are the chief exports, although tropical fruits and vegetables grow luxuriantly. The value therefore of the Danish Islands to any country lies almost wholly in the fine, land-locked, deep-water harbor of St. Thomas, commanding the geographical and strategic position on the highway between the two Americas. From November to May the



CASTLE OF CHAPULTEPEC, CITY OF MEXICO.

A famous historic edifice, and summer home of the President of the Mexican Republic.

climate is delightful, though for the rest of the year the weather is hot, but the nights are cool and refreshing. There is over the island a great mixture of customs, since the white people are intermixed nationalities of Danish, English, French and Spanish.

* * *

WHERE MEXICAN RULERS DWELL

"The hill of the grasshopper," as the word Chapultepec meant in its original Aztec significance, has long been a shrine of

Mexican history. Here Montezuma, the great ruler, had his palace, and here after the Spanish conquest dwelt Cortez, the conqueror. The successive Spanish viceroys occupied the palace on this hill, and when finally Mexico gained its independence, the successive dictators and presidents dwelt in the same place. When Maximilian came with his bride, Carlotta, to assume imperial authority over Mexico at the behest of Napoleon III., this was his home, and from it the young empress departed on her fruitless journey to Europe to obtain sup-

port from her royal relatives there. In later times, the castle has been the summer home of President Diaz, whose official residence the rest of the year has been in the government building in the city of Mexico.

Chapultepec lies but a few miles from the Mexican capital, with which it is connected by a beautiful boulevard called the Paseo de la Reforma. The present structure is more than a hundred years old and its splendid salons and corridors, its arched verandas which overlook the tree tops and the great city on the plain below, and the beautiful park which surrounds it, make it an enchanting residence. The American army cap-



GIANT CACTUS OF THE PRICKLY PEAR VARIETY, MEXICO.

tured this hill and castle during the Mexican War, after a spirited engagement and a brave defense from the occupants. The portion of the castle in the foreground is that occupied as the official residence of the president. The remainder of the structure is the School of Cadets, where young Mexicans are trained to be officers in the army, after the manner of our own West Point. It was these young soldiers who defended their school and the castle against the American army, and a beautiful monument now stands in the park below it, commemorating the bravery of those who died in the action. Near by, in the outlying part of the great park, are the ruins of the ancient Mexican mill which gave its name to the battle of Molino del Rey. In the foreground of the picture may be seen the arches of the ancient stone aqueduct which for hundreds of years supplied water to the householders of the City of Mexico. Supplanted by a modern water works system, as it is, with the rebuilding of Mexico into a modern city, the ancient aqueduct still forms a picturesque feature of the landscape.



MINES OF RICHES IN MEXICO

The Real del Monte mine was doubtless worked by natives long before the time of Cortez and Montezuma. From time immemorial it was the law of Mexico that a mine belonged to the one who worked it. Whenever he abandoned it any one else might take it. Thus the Real del Monte mine has been worked by many owners, the most noted of whom was Count Terreros. He took advantage of the law that a mine owner can own but the first five hundred feet in depth till he has exhausted that,

when he may begin on the second five hundred. Not far from Real del Monte was the Santa Brigida mine and he decided to cut into the second five hundred feet of that rich mine by tunneling from the bottom of the shaft of the Real del Monte. On the way he struck one rich vein after another until in the eleven years which it took him to complete the tunnel, he became the richest man in all Spain.

To show his gratitude he gave the king a million dollars in silver and presented the Spanish navy in the year 1762 with two ships of war fully manned and equipped. His other benefactions amounted to many millions of dollars, and not long before his death he was remembered by the king with the title of Count.

The descendants of Terreros worked this mine till the revolt of Hidalgo swept the country bare, and it was abandoned till an English company, knowing how rich it had been, put \$20,000,000 of machinery and labor into it with a loss in twenty-five years of \$3,000,000, when they abandoned it, and now the whole thing may be had for a song.

In 1775, Father Flores, a Dominican priest, who in his zeal had pushed far into the frontier of San Luis, was at last compelled to abandon his work because of utter unproductiveness, hopelessness and non-support. Gathering his most precious personal possessions in a bundle, he set forth to return to more civilized regions. The first night, with great difficulty he built a fire out of the green or water-soaked wood, but at last it was made glowing hot and he slept by it all night, wrapped in his blanket. A fierce wind storm came near morning and blew away every particle of the fire, and when he arose there was gloomy prospect that he could make another. But on the

bare earth where the fire had been, there were some shining white particles of metal. He examined them and found the out-croppings of a vein of silver. Then he remembered the dream of his boyhood, which had brought him there, in which an angel appeared and told him that he would be buried in a silver vault under a great church which he would erect in the far wilderness of Mexico.

Without disclosing his secret, he worked the mine alone for five years and the ore

by natives or priests who are contented with a bare sufficiency for support. Many of these are believed to contain fabulous riches equal to those whose one-fifth once made Spain the richest government and nation in the world.

The Santa Eulalia mines in Chihuahua are still rich producers, and the church still receives one sixty-fourth from the oldest of them as the result of a curious compact. In 1706 several desperadoes, confined in the prison, killed the guards and escaped to the

mountains, where they defied every effort at capture. As their crimes were particularly atrocious, the vigilance of the authorities never relaxed and a large reward was offered to the Indians for the robbers' scalps.

Such honors were about even, for the desperadoes fortified themselves in a cavern having secret outlets deep in the almost inaccessible mountains, and made the region uninhabitable.

One day a few years later, an Indian came to the padre of the village bearing a letter which

stated that the desperadoes desired forgiveness of church and state, not only because they now desired to live right the rest of their lives, but because the saints had prospered them so that they could make the padre and the governor rich beyond their wildest dreams.

The absolution and the pardon were soon secured, for which a vast amount of silver ore was turned over and a pact made that one sixty-fourth of the entire output of the mine should be set apart for the building of a great cathedral. In a few years the Cathedral of the City of Chihuahua was



MAGUEY PLANT, FROM WHICH PULQUE IS EXTRACTED.

brought him \$3,000,000. With this he opened it up on an extensive plan and before his death he had paid the royal fifth to the king of Spain amounting to more than \$20,000,000. The rest of his fortune he spent in settling emigrants upon well-equipped tracts of land, and in due time he rested according to his dream in the silver vault underneath the great stone church he had built. But today his mine is only a cave for the little animals that remain in the surrounding fields and woods.

There are hundreds of mines in the unknown mountain regions which are worked

begun and completed and equipped at a cost of \$2,000,000. The yield was above \$2,000,000 a year for nearly a century. Then the Apaches overran the country and the mines were abandoned for many years. At this time efforts are being made to recover the lost wealth of the mines.



PULQUE, THE NATIONAL DRINK OF MEXICO

The Spanish conquistadores, when they landed in Mexico under the leadership of Cortez in 1519, found the natives cultivating the maguey for the sake of the liquor extracted from it. There are said to be more than thirty varieties of the maguey in Mexico, and from most of them pulque (pronounced pool-kay) and other beverages may be made. About two-thirds of the number yield "agua miel" or honey-water, and from about one-fifth of the varieties of the plant the best liquor, called "pulque fino," is produced.

The maguey is to the native Mexican what the cocoanut tree is to the South Sea Islanders. It yields food, drink, clothing, shelter, and useful things of all sorts. The fibers of the leaf are used as thread and twine, and by breaking off one of the sharp thorns in which the leaves terminate, and rolling and twisting together the fibers attached to it, you have a needle and thread ready for use. Ropes made of the fibers are strong and lasting, though they are not quite so good as homespun ones. The pulp of the leaves furnishes a writing material like that prepared from the Egyptian papyrus. The earliest Mexican manuscripts, adorned with drawings and illuminations, were written upon maguey paper. The large, strong, glossy leaves of the plant

are also used to roof the houses of the poor, and from a leaf folded down its length spouts to conduct away the rain from the roofs are made.

The maguey is a plant of a striking and handsome appearance, and a great plain covered with row upon row of magueys at regular intervals, stretching uninterruptedly till the horizon or the boundary mountain range is reached, is a sight that cannot fail to impress the spectator. The leaves are eight or nine feet long, a foot wide and eight inches thick near the root. After several years there springs from the heart of the plant a great central shaft, upwards of twenty feet in height, and bearing many yellowish green flowers. But this exhausts the strength of the plant, and it soon afterward dies. As the maguey flowers but once in its life, and that only after many years of preparation, it is commonly known in the United States as the century plant, the notion being that it blooms only once in a hundred years.

The maguey on a pulque estate are planted in lines, with intervals of three yards between them. In suitable soil they require no attention until the period of productiveness is reached. This is by no means to be regularly calculated on; but it is believed that ten years may be taken as about an average time. By long and careful observation the natives have learned to know almost the exact time at which the great central flower-stem is about to appear. Just before this happens they cut into the plant and extract its heart, leaving only a thick outside rind serving as the wall of a reservoir, about two feet deep and eighteen inches across. Into this receptacle the sap intended by nature to supply nourishment for the tall flowering stem continually

oozes. In order to enable the native pulque-gatherer to approach conveniently near to the reservoir to draw off its contents, the leaves on one side of the plant are cut off. To extract the sap the Indian employs a long gourd, to one end of which a horn tube has been fitted, while at its other end is an aperture. The sap is drawn up into the gourd by suction, and is poured into a skin carried by a burro. When first extracted, the sap is called *agua miel*, or honey-water; it is either clear and straw-colored, or whitish and slightly sticky, according to the variety of maguey that produced it. It is almost without smell, and very sweet to the taste.

Pulque is produced by fermentation from the *agua miel*, and is a milky-white liquid, having just the appearance of soapy water; it is sweetish in taste, and contains about six per cent of alcohol. But its smell is peculiarly sour and rancid, and this, more than anything else, turns the stomach of the man that is learning to drink it. It is manufactured thus: Part of the honey-water is taken to a building, and is allowed to ferment for ten or fifteen days, so as to form *madre pulque*, "mother of pulque." Small portions of this mother-liquid are placed in the skins and vessels intended for the reception of the sap just drawn from the plant. As soon as the fresh sap comes in contact with the mother-liquid fermentation rapidly sets in, and in a day or two we have pulque, ready for drinking, and in the best possible condition.

The pulque is drawn off and taken to market; fresh *agua miel* is put into the vat, and the process thus goes on without interruption, so long as the plantation has magueys supplying sap. The amount of *agua miel* yielded by a good plant varies

from eight to fifteen pints a day, and this quantity is yielded for two or three months.

When a maguey plantation changes hands, its value is estimated by the number of maguey de corte, or plants ready to cut. These are usually taken, one with another, at five dollars apiece, though the actual value of a good plant is double this sum. But allowance has to be made for the loss of many plants, for if the heart of the plant is cut out too early, or the incision is not made until too late, the result is alike fatal. The plant dies, and yields none of the valuable sap. A good pulque plantation is an excellent thing to own, for the plant is strong, and not easily affected by heat or cold. Besides this it needs little moisture, and reproduces itself very readily by means of suckers from the old root, which withers down after all the sap had been drawn off from it. The pulque commands an almost immediate sale, for, so far as can be seen, it is impossible to produce too much of it.

With all these merits and advantages pulque culture has but two drawbacks; one is that several years must elapse before a new plantation begins to yield liquor to the thirsty and an income to the proprietor; the other is the considerable uncertainty as to the time at which the plant will flower; it may reach its maturity in eight years, or it may take eighteen. But a maguey estate once in full operation assures its proprietor of a steady income, for fresh plants are constantly becoming productive.

As pulque is much better when fresh, and rapidly deteriorates by keeping, the supply is renewed daily. From the plains of Apam, where most of the pulque consumed in the City of Mexico is produced, there is a daily train called "the pulque train," which is laden solely with the fav-

orite drink, and is one of the largest sources of income of the Mexican Railway. The daily consumption in the City of Mexico alone is said to be a quarter of a million pints, and there are 822 shops devoted to the sale of the national drink in that city. The maguey estates in the State of Puebla are valued at \$2,000,000; those in the State of Tlascala at twice as much, and those in the State of Hidalgo at four times this sum. The small towns and villages throughout Mexico receive their supply of pulque from the neighboring haciendas, or plantations, from which it is brought to market in barrels or sheep-skins.

Pulque, as one gets it at the city pulqueria or village tavern, is a sour-smelling liquid, with a curious rancid flavor, which excites repulsion at first. The practice of carrying it in the skins of sheep or hogs increases the strong odor, which is sometimes nearly as unpleasant as that of putrescent meat. However, though a strange drink, it is wholesome, and is believed by its admirers to conduce to good digestion, sleep and an easy conscience. It must be drunk in large quantities to produce intoxication; further, as it is always consumed while fermentation is still going on, it is pleasantly cool. The native Mexican is extravagantly fond of his national drink, as is shown by the oft-quoted:

Know ye not pulque?
That liquor divine!
Angels in heaven
Prefer it to wine.



MYSTERIOUS COPAN, A CITY OF THE DEAD IN HONDURAS

Centuries before Cortez overthrew Montezuma, there was a mighty Maya race in

Yucatan which reared some of the most extensive and costly temples ever made in the New World. Their civilization was much greater than that of the Aztec or Mexican.

In 1576 Diego Garcia sent a letter to Philip II. of Spain in which he said of Copan, "I have beheld ruins and vestiges of a great population and of superb edifices of such skill and splendor that it appears they could never have been built by the natives of that province." He added that he was unable to obtain from the natives or from any other source any legends or traditions that afforded any satisfactory origin for the remarkable buildings.

For three centuries this place was visited by sightseers of various nationalities, but it was only in the last decade that serious and extensive excavations were made. Enough has already been unearthed to show that no other city ever had such a vast amount of sculptured ornamentations. One stairway thirty feet in width ascending to the top of a pyramid 130 feet in height was carved every step with hieroglyphics and ornamented the entire way with images, some of them in groups of colossal size.

That Copan was once one of the most magnificent cities the world has ever seen can no longer be questioned, and that it was occupied for many ages is proven by the many styles of extensive repair, one upon the other, which have been unearthed. Once the tropical and semi-civilized regions of Yucatan and Honduras were the scene of a gorgeous civilization, rivaling that of Babylon and Rome in their greatest splendor. In southern Mexico, at Mitla, are other noteworthy ruins, far antedating any historic records as to when and by whom they were constructed.

QUITO, THE STRANGEST CITY IN THE WORLD

The capital of the Republic of the Equator, or Ecuador, occupies, among the capitals of the world, the position that some animals and flowers do in their respective kingdoms. It is a peculiarity, an anomaly, a paradox, if not a monstrosity. Just as some shrubs have leaves that simulate flowers, so Quito has some conditions which simulate the conditions of metropolitan existence, but the general effect is bizarre and strange.

Quito is a town of several thousands of inhabitants. No one quite knows whether there are forty or eighty thousand. Quito-nians say that there are eighty thousand inhabitants; strangers doubt if there are so many as half that number. The first peculiarity is that there are no chimneys to the houses, and consequently no smoke rises. Charcoal only is burned there, and thus the town is relieved from that oppressive and noxious cloud that makes some cities occasionally intolerable. A second peculiarity is that while the streets are well paved with cobblestones in the roadway, you may pass days in the town and never see a wheeled vehicle at all. There are some carriages at Quito, but they are rarely used; when one of them rattles along, every one will turn to look at it, as at some curiosity.

A third peculiarity is that while the bulk of the population is Indian in its character, dressed in ponchos and short linen trousers, you will see a considerable number of people, white men, walking about in frock coats and wearing tall hats. These, you will find, are the enlightened and cultivated white men, natives of Spanish

origin, who fancy that they form the nation of Ecuadorians—the Indians, of course, do not count. Every white man who can possibly manage it, wears, in Quito, a frock coat and a tall hat, to emphasize his importance and highly civilized condition. This dress justifies him in calling himself “Doctor,” and others in so styling him. Another peculiarity about Quito is that there is no hotel there. There is, indeed, a restaurant which calls itself an hotel. There are establishments where rooms can be hired for lodgings; but hotel, properly speaking, there is none.

The means of access to Quito are also remarkable. In the midst of a wide upland moor, some hundred miles away to the south, a paved road suddenly starts, and extends, with more or less interruption, to Quito, which it enters from the south. Along a portion of this road, twice a week, a broken-down old omnibus, drawn by six mules, with their backs and necks in various degrees of hideous rawness, urged on by the shrieks and shrill whistling of three drivers, rolls slowly into Quito. This is the only public conveyance in the interior. One or two bullock-carts may be met upon the road. All other communication with the outside world is on horse or mule back. Such are the facilities of intercourse with this city of Indians, tall hats, and less agreeable things.

Quito can only be reached by a journey, mainly on mule back, which, including ordinary stoppages, may occupy ten days, over one of the most difficult roads in the world. Starting from Guayaquil, a steamer takes you seventy miles up the fine stream of the Guayas to Babakoyo, alias Bodegas. There the mules must be packed, and thence you ride for eight hours along a road which, in the dry weather, may be called good, to

the foot of the Andes. Then comes a climb of 10,000 feet, part of it along rocky tracks to which the name of road can hardly be given. Then there is a descent of 2,000 feet to the valley of the Chimbo. From Guaranda there is an ascent of about 5,000 feet, and the shoulder of Chimborazo must be crossed. To cross Chimborazo, either you must go up to such a height that you run a considerable risk of suffering from

mountain sickness, or you may go by a slightly lower road, and run a considerable chance of being suffocated in mud, which is often up to your horse's girths. From Chimborazo to Ambato the great bleak moors have to be passed. From Ambato the coach to Quito may be taken.

It will be imagined that in traveling over such elevations some of the roads will be very bad. During the journey one has, in fact, to go over every sort, from the finest paved

causeway (almost unused) to entire absence of any track whatever. Sometimes the path leads over miles of rocks, which one could hardly imagine one could crawl along, yet which the mules manage to surmount. Sometimes it is through miles of mud, and through sloughs, where many poor beasts of burden are lying dead. Sometimes the slope is so steep that one wonders how to remain on the animal's back. Sometimes the road is converted into a torrent by the rain, or into a deadly slide

where there is no sure footing; sometimes it has given way, leaving but a few inches for passage. Sometimes a landslide blocks the way, save for a few inches on the precipice's edge. Sometimes one must wander over the boggy mountainside, as the road has simply become an obstacle to progress.

In the mountains the road, be it said, is at least a mere path cut from their sides, until Chimborazo has been reached and the



ALBATROSS COLONY ON THE COAST OF CHILE.

The guano used for fertilizing American farms comes from the rocky islets where myriads of these birds dwell.

long Interandine Valley attained, which is the chiefly populated portion of Ecuador. The scenery is entrancing, or rather would be so if two things permitted the soul to be entranced. One obstacle is the enormous amount of clouds, which, though sometimes a beauty, often mar the scene, so dense and continuous are they. The other obstacle is caused by the necessity of careful attention to the road and horse, and of hastening forward as quickly as possible. Rest-houses are rare, sometimes mere Indian hovels,

always foully filthy to a degree beyond powers of decent description. The rain is often torrential. When the road is dry, many of the difficulties and dangers disappear. But the cold winds on Chimborazo are often very formidable, and one must not stay long to admire his beauty. Apart from the glorious exuberance of the precipitous hillside forests on the maritime face of the Andes, and of the splendid sweep of the vast cereal-bearing valleys and slopes on the eastern aspect, there is much of surpassing loveliness; and, although in the rest-houses unspeakable filth and squalor prevail, there is interest and pleasure in the journey.

The climate is very equable. It rains for three hundred days in the year, and ordinarily in the afternoon. It is warmer out of doors than inside the house. A visitor is always requested to keep on his hat when he calls, as the rooms are so cold, and many people sit in their overcoats. The town is 9,300 feet above the sea, and to breathe is often a matter of great difficulty for the unacclimated. No stranger coming to Quito but wonders how he will ever get away again, and it is not likely that any person would wish to revisit this City of the Incas. Amongst the other deficiencies of this strange place is the entire absence of any cultivated society, with the exception of a few families. There are, on the other hand, some noisy military bands, and some of the tunes they play are lively. There is an observatory; but the astronomer has never yet taken the trouble to ascertain the true longitude of the place.

There are no greater thieves in the world than the Quitonians. If you pay a visit, your host unlocks his drawing-room door for you; the room is never left open. And each person leaving his room locks it be-

hind him. Pilfering is a fine art in Quito. The article to be appropriated is moved from place to place till it vanishes entirely. The houses are built round courtyards and the reception rooms are very fine; the carpets, mostly manufactured locally, are superb. The address of the whites is most courteous; hands are shaken on leave-taking at least three times, and the hat is taken off on going down the staircase to the courtyard.

The post arrives regularly. You will not be troubled with business, as no one ever thinks of keeping an engagement, and you will feel a great and lasting relief when you have literally shaken the dust of the place from off your feet.



LIMA, THE CITY OF MUD

Where else in the world will you find a city built of mud 300 years old? Lima, the capital of Peru, has more than 100,000 people, and it is built of mud. It is about six miles around it and two miles from one side of it to the other. It has a network of narrow streets, which cross one another at right angles, with spaces clipped out here and there for parks and plazas. The houses are all of one or two stories, flush with the sidewalks, and in the business sections cage-like balconies hang out from the second stories, so that you are shielded from the sun as you pass through the city.

Lima looks wonderfully substantial, and you would imagine it to be made of massive stone, which here and there is wonderfully carved. Some of the walls look like marble, others imitate granite, and houses of all the colors of the rainbow line the streets like substantial walls. About the chief

square there are enclosed balconies from the second story walled with glass, and under these are what look like massive stone pillars forming an arcade or cloister around two sides of the square in front of the stores. These pillars are of mud, the polished walls of the houses are made of sun-dried brick coated with plaster of paris, and the second stories are a combination of mud and bamboo cane. Think of a great city built of mud and fishing poles! That is Lima. There are some of the finest churches here on the continent, made of mud. The great cathedral of Lima, which cost millions, is a mud structure.

The street scenes of Lima are interesting. Let us stop under the arcade, which runs about the plaza, and watch the crowds. Here are some of the best shops of the city. They are full of fine goods, and here between four and five o'clock every afternoon the people come to buy and transact business. These hours are the gayest of the day, and the crowd is now as thick as that of lower Broadway in New York at noon. It is a far different crowd, however. No one hurries. The men saunter along or stand on the street, and chat with their friends. We see little knots of men every few yards, and the messengers, the merchants and clerks seem to have time and to spare. Nearly every one is well dressed.

The young women of Lima are a class nearer perfection in beauty of form than any others in South America. They are straight and shapely, and their soft, round, beautiful faces, with their luxuriant black hair combed high up from the foreheads, are lighted up with eyes which fairly shine with the souls of their owners. All of the ladies of Lima dress in black when they go out to walk. They do not wear bonnets, but

wrap fine shawls of black goods about their heads, pinning them fast on their backs, so that the face alone shows.

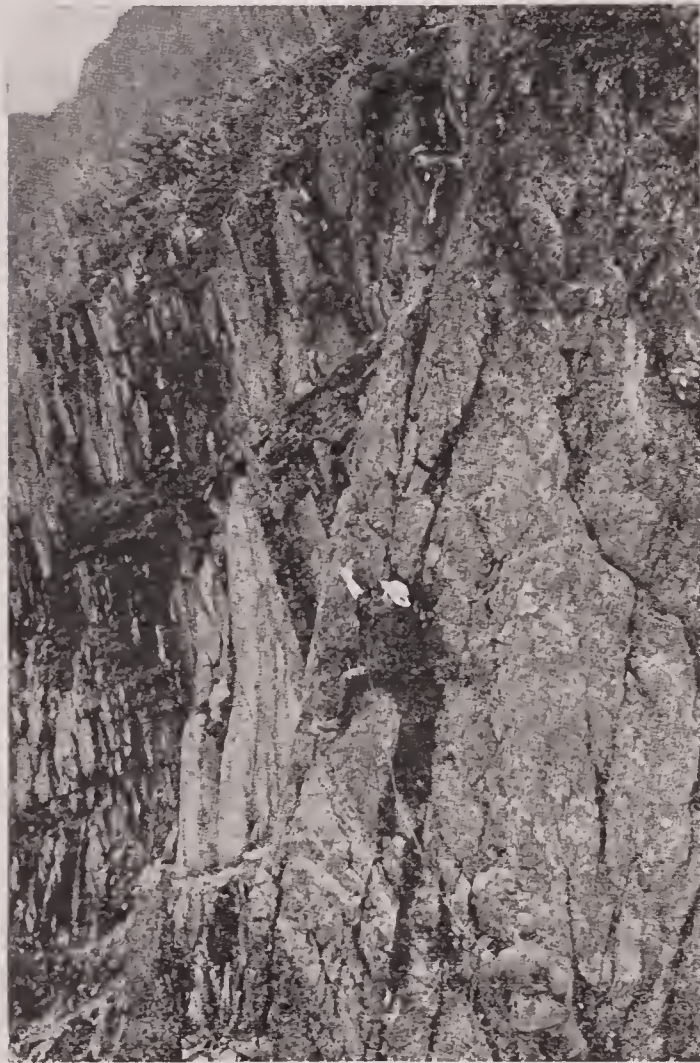
They are very devout. Every other one we meet carries a prayerbook, and you can seldom enter a church without finding a score or so on their knees. No woman can go into a church wearing a hat or a bonnet, and those who attempt to do so are touched with a long stick by the sexton and told to take their hats off. One of the queer sights of Lima is a church congregation. The men sit by themselves, and the women and girls, all wearing these black cloths on their heads, make you think of a congregation of nuns who are dead to the world. At their own homes, however, they are vivacious and charming, and dress much like their sisters of the rest of Christendom.



BOLIVIA, THE BACKWARD REPUBLIC

Bolivia is promised a boom. Most backward of South American countries though it has been of late years, North American enterprise has centered its attention upon the land of the Incas, and the rapid development of its agricultural, mineral and commercial interests is prophesied. Source of great riches as they were to Spain a few centuries ago, Bolivia and Peru have been left far behind in the march of progress in the last hundred years. The mines of gold and silver from which were loaded the galleons which sailed away to Spain, were virtually abandoned. The thrall of *mañana* fell over natives and Spanish colonists alike, and all advance seemed at an end. Within the last year or two, American capitalists have been turning their attention to

this country that was still living in the past, in the belief that its natural resources justified energetic development. And so they have obtained concessions from the Bolivian government by which they have large privileges in financial, mining, railway, agricultural and industrial enterprises, and it is believed that a new day is dawning for this "land of the llama." So we may ex-



MOUNTAIN CLIMBING.

pect to see the peculiar grass boats of Lake Titicaca superseded by American-built steamers, and the toilsome stage journey over the high roads of the Andes abolished in favor of an American railway train which shall penetrate the range by passes and tunnels. The rich forests of rubber, the gold and copper mines of the Incas, and the other natural wealth of this country will

be levied upon to pay a tribute to Yankee energy and business sagacity.



CLIMBING THE HIGHEST AMERICAN MOUNTAIN

Aconcagua is the highest mountain in South America, and consequently in the Western Hemisphere, for we have no peak in North America that equals it. The great mountain which rears its summit 22,422 feet into the air, or more than four miles, is in the Andes range, about 100 miles from the Pacific Ocean, almost due east of Valparaiso, on the boundary between Chile and the Argentine Republic.

Few mountain-climbers have had the hardihood to attempt this peak, owing to the difficulties of the ascent. You pant like a dying consumptive; then the dust, which smothers everything, gets into your throat and chokes you; you cough exhaustingly and pant worse than ever. Every effort, however slight, entails a fresh effort of will, and your only desire in the world is to give up the whole thing and get down. At times the view is indescribably splendid, but as a rule dust-storms blot out the sky. Rain never falls at these heights.

Starting from their camp at 8 a. m., the geologists of the first expedition that succeeded in reaching the top, and an Italian porter, gained the summit in nine hours. Owing to the violence and persistence of the wind, snow only lies in great patches on the peak. Avoiding these, they struggled up through deep masses of rotten, rocky material, slipping back two feet for every three they stepped. During the latter portion of the ascent they were forced to stop every four or five yards for two or three

minutes, stooping forward to recover breath. They remained an hour on the summit, which they measured and found to be a small plateau seventy yards square. The view was magnificent, and the Pacific, one hundred miles away, resembled a vast, unruffled pond. In the afternoon, when the sun shone in the west, the ocean appeared like an immense conflagration or tract of

levels, the dangers from mountain torrents and avalanches. Also, all suffer more or less from fever, and most of the mountain streams are poisonous, owing to the presence of some mineral in the water. With such difficulties and innumerable lesser ones, it requires courage and endurance of the highest order to reach the tops of the great cloud-piercing peaks.



SHEEP SHEARERS TRAVELING ON THE SOUTH AMERICAN PAMPAS.

fire. The clouds, however, only parted occasionally, and a sort of haziness prevailed throughout the day. Respiration was exceedingly difficult, and finally a gale arose, which prevented a longer stay. On the east side the mountain falls away in a stupendous precipice of 10,000 feet, with hanging glaciers that feed a considerable glacier below.

It will be seen from what has been said that the difficulties to be encountered through bad weather, exposure to severe cold, and above all the dreaded "puna" or mountain sickness, are of no ordinary character. To these must be added, at lower

Aconcagua can be seen from Valparaiso, rising over the horizon far above the black ridge of the Andes.



PROSPERITY IN THE ARGENTINE REPUBLIC

Argentina and La Plata are the silver republic and the silver river, according to the derivation of the words, but neither of them is silver except in the imagination of the discoverer. The Silver River is the hue of yellow mud and the chief products of the country have long been cattle, wool and wheat. For many years there was such a

surplus of horses that a good one could be bought for less than a dollar, and it was no uncommon thing to see a ragged vagabond on a horse holding out his hat to passers by and saying, "Alms, please, for the love of God." "If wishes were horses, beggars would ride," is the old saying that was long fulfilled in Argentina.

The soil being very loose in the country about Buenos Ayres there is always either insurpassable mud or almost unendurable clouds of dust. Besides this, ants are almost intolerable pests. They increase with incredible rapidity, and often the mud houses they build are large and strong enough to support three or four horses abreast. Buenos Ayres is nearly as large as any other two South American cities, having 750,000 inhabitants, one-half of whom are foreign. It is built on level land, and the houses, mostly of one story, have continuous low, flat roofs. There is a line of horse cars along every street, and these are well patronized, for few persons

will walk farther than one of the long blocks.

Out on the vast pampas or plains, many of the great ranches, where there were formerly five or six thousand head of cattle or horses, are now converted into wheat fields, some of them several miles square. Within ten years of the time when wheat was imported into Argentina, nearly a million tons were annually exported.

Foreigners are known among the natives as Gringos, and it is said that they received this name from a party of young Englishmen, the first in the country, who often sang together the old song, "Green grow the rushes O." Henceforth, all foreigners were known as "green grows" or gringos.

The rage for speculation in Argentina since 1885 has resulted in building up the country at an incredible rate, and it resembles in many places the aspects of some of the "boom" districts of Kansas and Oklahoma.



COLLECTING ALBATROSS EGGS FOR MARKET ON A SOUTH PACIFIC ISLAND.

PARAGUAY AND ITS HISTORY OF VIOLENCE

The little state of Paraguay, considerably smaller than the area of Indiana and Illinois, wedged in between Brazil and Argentina, has suffered more disastrous calamities from political mismanagement than any other state of South America.

Three-fourths of the natives were killed in the Spanish conquest, which far surpassed in brutality all the feats of Cortez and Pizarro. The mild-mannered Franciscans then obtained concessions, covering most of the territory, and after somewhat pacifying the intimidated natives were superseded by the more energetic Jesuits, who at once achieved remarkable success in converting and controlling the people. So great became the power of the Jesuits that no one could enter the country without their permission, not even the soldiers or envoys of the king. Their absolute control continued until 1768, when they were expelled by the fire and sword of rebellion, so that hardly anything was left but dead men and ruins.

In 1811 it became a republic and for sixty years was ruled by dictators who were unlimited despots. The story of their atrocious tyranny reads as if taken from the lives of Bluebeards and the rulers of ancient Delhi.

In 1865, Brazil, Argentina and Uruguay united in war against Marshal Lopez, then dictator of Paraguay, and in five years the population was reduced to one-fourth, and less than one-tenth of the perishable property of the country remained. This was one of the most obstinately fought wars in history. It was said that one might ride all day through formerly populous districts

and not see half a dozen able bodied men. There remained almost none but women and children.

Fewer than a hundred officers of any grade, civil or military, remained with whom the conquerors could make a treaty. These appointed a triumvirate, to whom was given the task of reorganizing the desolate and prostrate nation. They adopted a constitution in 1870, and since then Paraguay has been peaceful and progressive.



INDIA RUBBER IN THE BRAZILIAN FORESTS

It was from South America that india rubber was first introduced into Europe by the French scientist, La Condamine, who reported that the Peruvian Indians made use of it for many purposes. This was in 1736, but it was not until 1770 that an English artist discovered its efficacy for effacing pencil marks, hence its name of rubber. It is distinguished from gutta-percha by its greater elasticity, a property which the latter loses when kept in a cool temperature, for which reason it is used in the insulation of sub-marine cables.

The rubber of the Amazonian forests commands the highest price, that from the upper Amazon having a slight advantage in this respect over that of the lower valley, because from the greater distance it has to travel, it reaches the port of shipment in a drier condition. The tree producing it, known by various names among the natives of different parts of the country, was named *Hevea Guyanensis* by Aublet, a French botanist, who studied it in French Guiana. It is an inconspicuous tree, with trifoliate leaves, growing to a height of over 60 feet,

and is compared in general appearance to an English ash. It flourishes best on islands or ground that is periodically inundated, and requires the shade of other trees, as well as a still atmosphere, in order to give an abundant supply of the milky juice which hardens into gum.

It requires fifteen years to mature, and is not cultivated artificially, but the supply is practically inexhaustible, as it is reproduced by nature even after the temporary exhaustion of a district. This has occurred in the case of Cameta on the Tocantins, for forty years resorted to by thousands in search of fortune. There are many regions still untapped, and the known area of production, which probably will be largely extended, exceeds 1,000,000 square miles. The most prolific districts are on the lower islands of the main stream, and on its southern tributaries, on one of which there are 100 trees which yield 100 tons of rub-

ber per annum. The manufacture of waterproof clothing from india rubber was introduced into France at the end of the eighteenth century, after which it was developed on a very extensive scale by the firm of Macintosh, of Manchester, which has left its name to this class of goods.

At this time the uses of rubber have so multiplied that a mere catalogue of them would fill pages. It is so common that we think little of it, but if the supply were to cease suddenly we would realize in full measure the importance which it has gained in our everyday life. Only to mention erasers, rubber bands, waterproof garments, rubber bags, medical and surgical supplies, rubber stamps, flexible tubing, springs and cushions and engine packing, suggests in slight degree the manifold applications to which the preparations of rubber from the South American forests are put.



FLOWER FARM IN THE SCILLY ISLANDS.

This group of islands lies just off the extreme southwestern point of England. The climate is mild, and many flowers are raised for the perfume manufacturers.

LONDON, THE WORLD'S METROPOLIS

Of all the world, London is the greatest city. Other cities have their distinctions of beauty, of gaiety, of art, of music, but none rivals London in population or in the magnitude of its financial, commercial and industrial interests. All the world recognizes London as the international capital of commerce. And yet by no stretch of the imagination can London be termed beautiful. Overhung by the pall of smoke from its myriad chimneys, or shrouded in fog from its surrounding waters, monotonous of architecture, dull of color, it still possesses attractions all its own for every stranger, and stimulates in its own people the profound and loyal conviction that it is the queen of all cities.

And there is reason in all this. In London have been fought out numberless struggles for liberty that have produced results which all the world shares. London was the ancient city of the Britons when the Romans came nineteen hundred years ago, and nineteen centuries of history and romance have heaped upon it a dignity that compels admiration. Merely to name Westminster Abbey, the Tower of London, St. Paul's Cathedral, London Bridge, and the Thames, suggests enough of interest to justify a journey around the world. Trafalgar Square with its monument in honor of Lord Nelson, its colossal lions designed by Landseer, its fountains and magnificent National Gallery, and its great hotels



TRAFALGAR SQUARE AND NELSON MONUMENT, LONDON.

adjacent, is a center from which radiate a dozen famous streets on which every building occupies a historic site. This may be taken as the most typical center of London's social, official and political life.

Far from Trafalgar Square is another center of activity which is even more influential upon the affairs of the people of the world. It is the irregular area upon which the great financial institutions of London face. The Bank of England, the Mansion House, the Royal Exchange, and other institutions only second in importance to these, are neighbors here. The Bank of England itself, low, massive, and unpretentious in appearance, keeps from \$75,000,000 to \$100,000,000 in its vaults, and "the little old lady of Threadneedle street" is the most influential of all financial



WESTMINSTER ABBEY.

factors in the world of English commerce. Cheapside, a typical London street, filled with handsome shops, leads from the bank to St. Paul's cathedral. Half way between is Bow Church, and according to London rule, everybody born within sound of its bells is a "cockney."

It is not far from the Bank to the Tower of London, by way of winding, narrow streets, for this is the oldest part of the metropolis. But within sight of the Tower and almost connecting with it is the newest of bridges across the Thames, the great Tower Bridge itself. This remarkable structure is unique in bridge architecture, and it never fails to arouse the utmost interest. Two great towers surmount the piers of the bridge, and are connected with the shore by permanent roadways, sup-



CHEAPSIDE, LONDON.

Showing Bow Church in the Distance.

ported by unique curved suspension trusses. Between the tops of the towers the channel of the river is spanned by another permanent structure, high in the air. The roadway proper of the central span of the bridge, is of the bascule type, hung upon great axles at either tower. When no vessel desires to pass, this roadway is continuous with the spans which reach the shore, and

Manifestly, vehicles must wait while the bridge is open for boats, but great passenger elevators, running in the tower at either side of the arches, carry pedestrians to the upper level, and they cross, descending on the other side, so that foot-travel is uninterrupted. It will be interesting to the reader to note in comparison with this bridge, another peculiar tower structure of



THE TOWER BRIDGE, LONDON.

Looking through the open bridge the Tower of London itself may be seen and the Custom House is at the extreme left of the picture.

traffic passes directly across through the arches in the towers themselves. When it is necessary to permit the passage of a steamer, the two halves of this central span are turned on their axles until they stand vertically against the tower, blocking the arches and leaving the channel clear. Immense counter-weights permit this to be done with slight expenditure of power.

different type, which spans the Chicago River and is pictured elsewhere in this volume.

Still another feature of London interest is the Crystal Palace, which stands on high ground at Sydenham. This was the pioneer of world's fair buildings. It was erected in 1853 at a cost of \$7,500,000, for the first international exposition that had ever been

held. The central hall is 1,608 feet long. The immense structure is composed almost entirely of iron and glass, and it is still utilized for various expositions and amusement purposes.

A type of still another phase of the life of the great metropolis is shown in the illustration which depicts the vast Smithfield market and the streets adjoining it. This occupies the ground once used for the

don. For a comparison with the market illustration elsewhere, observe the picture of South Water street, Chicago, where the food supplies of the great American city are bought and sold.

Every city of large size has its distinct individuality as truly as has every man. The study of cities is one of the most interesting rewards of travel, and the selected views of London here included will serve to



THE CRYSTAL PALACE, LONDON.

This was built under the direction of Prince Albert, husband of Queen Victoria, in 1853, for the first International Exposition, the Pioneer of World's Fairs.

revels, miracles and tournaments of Bartholomew Fair, and later for the martyrdoms under Bloody Mary and Elizabeth. Here also Wat Tyler and Sir William Wallace were put to death. Nearby are the "Bluecoat Boys" school, Newgate, the famous prison, and other historic edifices. To-day the market, with three and a half acres under roof, is the chief place for the distribution of market supplies, fruits, vegetables and meats, for the city of Lon-

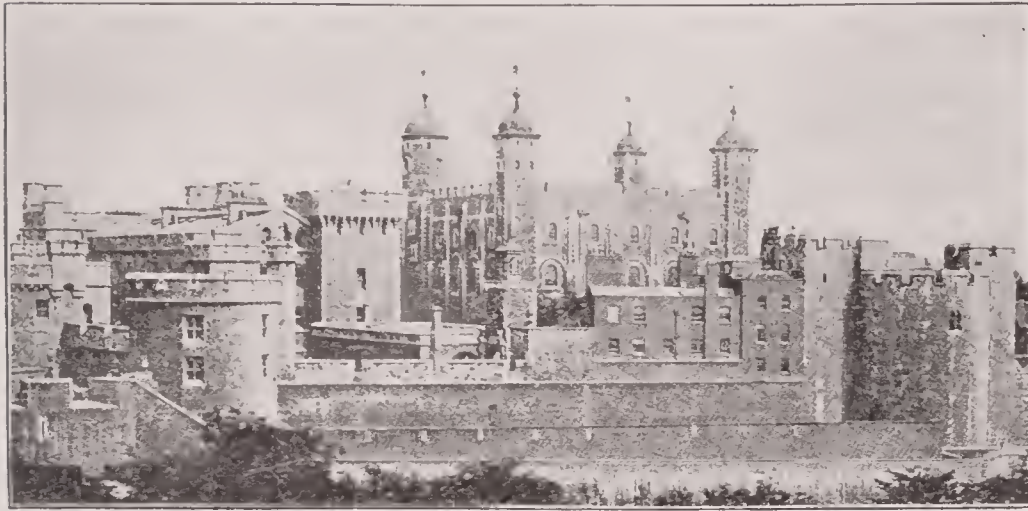
typify for the reader the characteristics of that greatest metropolis.



THE TOWER OF LONDON

On the left bank of the River Thames, just below where the Custom-House is, in convenient juxtaposition with the magnificent docks which, with their crowded tiers of shipping, their innumerable flags and

vast variety of languages, place modern trade and universality of interest at once face to face with ancient isolation and power,—is seen, as we go down in a steam-



THE TOWER OF LONDON.

But however this may be, the first historic record of its erection is in the reign of William the Conqueror, who built the White Tower to curb the rebellious Saxons, under the superintendence of his architect Gundulf, who, besides handling the measuring line, found time to exercise the duties, or at least to spend the emoluments, of the Bishopric of Rochester.

In the course of time it offered such security against attack, that it became an object of great importance to the factions into which this kingdom was divided. It was strengthened by walls and bastions. Kings fled to it for safety, or intrust-

boat for a day's holiday to Greenwich, a square-built, low and dingy pile, which has no feature of attraction either from grandeur or beauty of design, but which all turn to look at when they are told it is the Tower of London. Who originally built it is not known. Some, of course, say Julius Caesar; others are more modest, and say it was built in the time of Constantine the Great; and there are certainly some very strong proofs that on this site stood a fortress, a mint, or other building of the Romans in the time of Honorius, or three hundred and ninety-five years after Christ.



CANTERBURY CATHEDRAL, BUILT 1070-1184.

ed it to the favored of their vassals. Armed men were ready to be let loose with fire and sword on the disobedient or discontented citizens of London; dungeons were added to the other chambers of the castle; prisoners of consequence were committed to its impenetrable walls; Jews were tortured till they surrendered the last farthing of their hard-earned gains. Patriots, like the Scottish Wallace, or the Welsh Llewellyn, expiated their hatred of oppression with their blood in these miserable dens; and by the time it had arrived at its greatest strength, and very nearly at its present form and extent, in the reign of Edward III., it was a name which created an involuntary shudder in the stoutest hearts. From it went in procession on their coronation days all the kings of England, from Richard II. to James II., a period of 300 years. The Tower throughout the life of the first of these potentates played a very conspicuous part. It was the scene of the grandeur and magnificence of his youthful days. Festivals and assemblies were held in it, that eclipsed the magnificence of the Court of France.

Tyranny, ambition, cruelty, ignorance and superstition, all by turns opened those dismal portals, which were only once again to turn on their hinges, when the murderer slipped in to do his dreadful work in secret, or the prisoner was openly conducted to death upon the scaffold. Nobles, warriors, heroes, statesmen, judges and scholars, even the beauty of women and the dignity of queens, could not escape the dreadful doom; and very frightful is it to read, in the records of that awful prison-house, the names of patriots and martyrs of which England is now so proud; and still more dreadful to reflect, that those great and illustrious

names which still survive are but the scattered mountain-tops, as it were, on which the light of history has rested. But what are we to think of the valleys where the sunshine has never shone, the unnumbered, unnamed, unregarded prisoners who pined in those gloomy vaults, and counted the hours in vain, shut out forever from the upper world, condemned without trial, and executed without justice! We can talk now with some patience of these things, because they have ceased to be enacted for so long, because the light of the Reformation and the law of the constitution have made their way into that unhallowed building as into our private houses, and modern civilization has converted it into an arsenal for arms, and a pleasant quarter for a few soldiers, a sight for tourists on their holidays, and a comfortable command for a time-honored general.



INTERESTING FACTS CONCERNING GREAT BRITAIN

The Established Church of England is Protestant Episcopal. The king is by law the supreme governor of the church. The number of Roman Catholics in England and Wales in 1891 was 1,500,000. The number of Jews in England and Ireland in 1891 was 93,200.

The total area of the United Kingdom, exclusive of foreshores and tidal water, is 77,109,000 acres; 13,504,000 acres are uncultivable as mountains, waters, roads, etc.; 3,038,000 are woods and forests; 23,412,000 are grazing lands as hills and heather; 37,156,000 are under crop and grass. That is, the United Kingdom of England, Ireland, Scotland and Wales has

a cultivatable soil of little larger area than the state of Illinois.

In 1900 the total imports, exclusive of diamonds, bullion and specie, were nearly \$3,000,000,000. The total exports were about half as much.

On Jan. 1, 1900, England and Wales together had 15,044 miles of railroad, Scotland 3,480, and Ireland 3,176.



THE CATHEDRALS OF ENGLAND

Cathedrals are the petrified prayers of architecture. They represent the highest ideas of man in the beauty and splendor of worshipful art. Such edifices have, from all time, been the chief evidence of the advancement of the nation and age.

Of modern nations, if not of all nations, England is foremost in the excellence if not in the massiveness of her cathedrals. So closely woven everywhere have been church and state that the history of the cathedrals is almost the history of the nation.

The historian Macaulay spent every Eastertide in a prolonged visit to all the cathedrals. The historian Green says that the stately vault which covers the tomb of the Conqueror, contains in its structure the whole story of the conquest. It was at Ely in the midst of the fenlands that Hereward, the last native Briton, refused to surrender to the invading Anglo-Saxon. At Canterbury we have the tragic romance of Thomas à Becket in the time of Henry II.

Canterbury has within it the throne of Augustine, and was begun by Lanfranc in 1070. The mosaic pavement still remains upon which Becket lay as his body was watched by the monks of the abbey during the night after his murder. In 1538, 368

years after Thomas à Becket's death, Henry VIII., he of the many wives, issued a writ of summons to the said Archbishop of Canterbury, commanding him to appear to answer to the charge of treason, contumacy and rebellion. The summons was read before the tomb, and, as the accused did not come forth, the trial was conducted at Westminster, where, the defendant not putting in an appearance, an advocate was named to represent him.

The trial resulted in favor of the crown, with a verdict that the man be burned and his property confiscated by the king. Accordingly the tomb was broken open, before which millions had prostrated themselves, including Emperor Charles V. of Spain, Edward I. and Richard the Lion Heart, and the remains were taken out and burnt. The shrine over him was destroyed and it was found to contain twenty-six cart loads of gold and jewels, among which was the carbuncle, as large as a hen's egg, contributed by Louis VII. of France.

Nevertheless there is a tooth of Becket's enshrined at Verona, part of an arm at Florence, another at Mons, the bones of one of his legs at Lisbon, while personal articles of his are scattered all over Europe, and every county in England has a church or a convent dedicated to him. It is of a pilgrimage to the shrine and tomb of Thomas à Becket that Chaucer wrote in his *Canterbury Tales*. In Trinity Chapel, the most sacred spot of the cathedral, is the tomb of the Black Prince. A long line of illustrious men and heroes are elsewhere entombed in and about the cathedral.

Winchester Cathedral is most noted from an architectural point of view, for it contains some design or addition that shows the architecture of every century for nearly

a thousand years. The most illustrious tomb here is that of William Rufus, who is buried under the central tower. The magnificent and massive structure of Durham Cathedral is situated on a rocky eminence over the River Weir. Its most noted occupant is Venerable Bede, whose remains were stolen from Jarrow and deposited here in 1022.

The Cathedral of Salisbury was begun in 1220 and has a complete written record of everything concerning it from the first. Its spire is the loftiest in England, being 406 feet. It was completed in 40 years and cost more than \$2,500,000.

Westminster Abbey, though not a cathedral, is the most noted place of worship in England. It is officially known as the Collegiate Church of St. Peter. The church was consecrated in 1065. William the Conqueror was crowned there in 1163. It is the burial place of thirteen kings of England and of five queens who were queens in their own right. Many of England's greatest literary men from Chaucer to Tennyson are buried there, not to speak of the great statesmen, scientists and warriors. Nearly all of the English kings and queens have been crowned there and since the time of Edward I. have used the same chair, underneath which is the holy stone of Scone. Its various parts have been constructed by the master architects of the world. In its law courts have been argued some of the greatest trials of England. No place in Great Britain has such a voluminous history as Westminster Abbey. Among the names that appear on tombs or memorial tablets in Westminster Abbey, are those of Chatham, Peel, Cobden, Pitt, Isaac Newton, Dr. Watts, John Wesley, Major André, Livingstone and Gladstone.

WELSH EISTEDDFODS, BARDS AND DRUIDS

An Eisteddfod is an assembly of Welshmen for the purpose of hearing speeches, essays, music and poetry in the Welsh tongue, for all of which subjects prizes are offered, frequently amounting to a very considerable sum. These meetings are known to have been held, as early as the sixth century, on an eminence near the now fashionable watering place of Llandudno, although the first, of which there is a detailed account, did not take place until 1176, when Rhys ap Gryffydd, Prince of Wales, held a congress in Cardigan Castle, on which occasion the prize for poetry was gained by a North Welshman.

The opening of the Eisteddfod is usually preceded by some mysterious ceremonies called the Gorsedd, for which a pedigree is claimed dating from 1,000 years before the Christian era, and which can be conducted only by those who are initiated into the sacred rites.

The place for holding the Gorsedd is usually an open space, in the center of which is a huge stone, the "Maen Llog," surrounded by a circle, thirty feet in diameter, of twelve other stones, supposed to represent the signs of the Zodiac. On the outside of the eastern portion of the circle three other stones are placed, in such a position as regards the Gorsedd stone, that lines drawn from it to them will indicate the rising of the sun in the summer and winter solstices, and the equinoxes respectively. The form which these lines, or pencils of light as they are termed, would assume in the mystic symbol of the bards and druids, and when written down appear thus, is in fact the druidic expression for the Creator of all things. To this Gorsedd stone a

solemn procession is formed, which is at least curious and picturesque, owing to the peculiar dresses assumed by the different orders. The color of the bards is blue, to symbolize the blue sky, and supposed to indicate peace and tranquillity; the druids are dressed in white, significant of great purity; and the ovates or candidates for the highest orders are habited in green, to represent the grass of the field, which is typical of growth and progress.

Another singular custom is the carrying of a sword by a bard, who holds it by the point, to show that he is a man of peace, and would rather turn the weapon against himself than against any others.

On arriving at the circle, a prayer, said to have been composed 1,300 years ago, is recited to the following effect:

May Heaven grant strength,
And to strength add understanding,
And to understanding, knowledge,
And to knowledge, what is just,
And to what is just, love,
And to love, the love of all things,
And in the love of all things, the love of God.

As soon as the prayer is finished, the Gorsedd is declared to be opened, and the business of conferring degrees on the bards and ovates is proceeded with. Of the three orders the ovate is the lowest.

Under the old druidic dispensation, he was required to devote twenty years of his life before he could qualify as a bard, to gain which honor he had to study the laws and maxims of the institution, generally in verse, besides using his brains to compose fresh ones. At the expiration of his time he became a bard, which gave him the privilege of holding or presiding at Gorsedds, as well as instructing disciples, which was

usually done in a series of pithy truisms called triads. Although they are full, even to repletion, of wisdom, they are characterized a good deal by repetition, and were sometimes not a little obscure to ordinary mortals who had not the advantage of studying them for twenty years; as for instance, "the three dignitaries of poetry are the praise of goodness, the memory of what is remarkable, and the invigoration of the affections." And again, "three things to be chiefly considered in poetical illustration, —what shall be obviously, what shall be instantly admired, and what shall be eminently characteristic." Some of these "proverbial philosophies" are rather graceful, as "the three primary requisites of poetical genius: an eye that can see nature, a heart that can feel nature, and a resolution that dares follow nature." Literature, however, was not the only thing that the bards had to look after, for morals also came within their scope, as we find that the three ultimate objects of bardism were "to form morals, secure peace, and follow everything that is good,"—a delightfully comprehensive view of the whole duty of man, which was still further carried out by "the three things forbidden to bards—immorality, satire, and bearing of arms."



THE ROUND TOWERS OF IRELAND

There exists, or are known to have existed, in Ireland at least 100 examples of the mysterious round towers. Eighteen of these may be classed as still perfect, or nearly so. About as many more have entirely disappeared, but their former existence is well authenticated. The rest, in-

cluding those of which only the foundations remain, exist in various stages of ruin. The large majority of them stand detached from any other building, but some nine or ten were structurally connected with a church. Besides, these, there are, or were, two in Scotland, seven in the Orkney, Shetland and Faroe Islands, and one in the Isle of Man. These latter may be regarded as outlying members of the Irish group. There are, moreover, a few Round Towers in Italy, Germany, Belgium and France, which present a considerable resemblance to the Irish type, and are believed to belong to the same period or, at least, to be the outcome of the same movement.

The average height of the isolated Round



ONE OF THE NOTED ROUND TOWERS.
Height, 84 feet; diameter, 15 feet.

Towers when perfect was probably about 100 feet. The average diameter at the base is about 20 feet, the thickness of the walls at the door level about 3 feet 6 inches, and the height of the door above the ground about 12 feet. The tower at Kilmacduagh, County Galway, is the largest example remaining. Though it has lost its conical cap and part of the upper story, it is still 120 feet high, with walls 4 feet 4 inches thick, and the doorway is placed as much as 26 feet above the ground. The towers generally start from a projecting base consisting of one or more plinths, diminish slightly in circumference all the way up, and terminate, when perfect, in a conical cap. The interior is divided into stories from four to eight in number, according to the height of the tower. These stories are in general marked by offsets in the masonry, or by corbels, or by holes to receive the joists. The floors appear to have been usually of wood, though in at least three cases, at Castledermot, Meelick and Kinneigh, the lowest floor is of stone. In the top story there are generally four apertures, but there are examples in which two, five, six and eight are found. There is generally a single window, variously placed, in each of the other stories; one of exceptionally large size is often found directly over the doorway. Individual Round Towers exhibit many important peculiarities not noticed in this summary description. But viewed as a whole, one of the most remarkable points to observe is the strong family resemblance that characterizes all the isolated Round Towers. It is impossible to mistake a member of the class.

Petrie's conclusions as to the origin and use of the Round Towers were stated by



ST. PATRICK'S GRAVE AT DOWNPATRICK,
IRELAND.

himself as follows: "That the towers are of Christian and ecclesiastical origin, and were erected at various periods between the fifth and thirteenth centuries. That they were designed to answer, at least, a two-fold use, namely, to serve as belfries, and as keeps or places of strength, in which the sacred utensils, books, relics, and other valuables were deposited, and into which the ecclesiastics, to whom they belonged, could retire for security in cases of sudden predatory attack. That they were probably also used, when occasion required, as beacons and watch-towers."

The first conclusion, so far as it maintains the Christian and ecclesiastical origin of the Round Towers, is now generally accepted. But as to the period of their erection, the more cautious archaeologists are now agreed that even the earliest examples were not built before the close of the ninth century. The second conclusion, that the towers were erected to serve both as keeps and belfries, is the theory now generally held, though some, who in other respects

have followed Petrie, dispute their original use as belfries; but Petrie's position in this respect has been much strengthened by arguments not open to him to use, while he assigned so early a date as the fifth and three succeeding centuries to the erection of these structures.

As to the third conclusion, that the towers were occasionally used as beacons and watch-towers, Petrie himself did not lay any stress on this position, and we may here dismiss it with a few words. There is really no direct evidence for either use. That in times of apprehended attack, however, they were used as watch-towers is extremely probable, and it may be said to follow from their character as keeps; but that a light was kept burning at night in the top story to guide the traveler or pilgrim to the house of hospitality or prayer, which is what Petrie meant, seems very unlikely. With a solid stone cap above, wooden floors beneath, and the lights available, such a use could hardly be safe, or effective, or consistent with the other purposes of the building.



CASTLES OF FRANCE.

Castles are always romantic, for they bring into the imagination the story of feudal times, when one man's desire was law within those walls, and the people round about were his vassals if not his slaves.

Touraine was the chosen residence of the French kings of the Valois line, down to Louis XIV., and the Castle of Blois is both ancient and famous. For centuries it was the abode of the high and mighty ones of the earth, where were enacted scenes from the most revolting crimes to

the most momentous events, including the monstrous assassination of the Guises and the opening events of the wondrous career of the Maid of Orleans.

Chambord is one of the most magnificent castles in all France. It was built by Francis I., after his long captivity in Spain, on the site of a hunting lodge of the Count of Blois, in the year 1525. The chateau contains 180 large rooms. In the center of the building rises a huge round tower, in which there are two concealed spiral stairways, so that persons may go up or down without seeing each other.

Ambois was long the residence of French kings. It has two towers, each 90 feet in height and 42 feet in circumference. The walls of the castle are from ten to fifteen feet in thickness and underneath are subterranean dungeons equal to the worst stories of romance. These underground prisons are so large that at one time they contained 1,200 Huguenot prisoners, who were all beheaded in one day at the moat near by. They were executed because of a conspiracy to extricate Francis, the husband of Mary, Queen of Scots, from captivity by the Guises. This was in 1560. The plot was somehow betrayed and hundreds were seized and thrown at night into the river Loire. To such an awful extent was the butchery of the Huguenots around the castle, without burial, that the chateau was made uninhabitable for a year.

Chenonceau has a different story. It was, like Chambord, built by Francis I., but at a time a little later, when he was in the height of his prosperity. It is to-day almost exactly as it was in his time, and many rooms used by illustrious persons are still kept as when last used by them. It was the home of Mary, Queen of Scots,

while in France. Her mirror is still shown to the visitor. Here lived for many years the detested Catherine de Medici, and in the latter part of the eighteenth century, while the home of Madame Dupin, it was made the refuge for eminent literary men such as Voltaire, Bolingbroke and Rousseau.

However, the castle with which is connected the most romantically terrible and gloomy stories is the Castle of Loches. It was made the prison of state during the reign of Louis XI. on account of its labyrinth of hidden underground passages and secret subterranean dungeons. It is now in ruins, for no one cares to live there on account of the memories of the victims of its numberless horrible crimes. Many of the deepest dungeons were merely sunken iron cages in which the victims of political or social intrigue were placed to perish.

It was erected about the year 1025, by one of the Counts of Anjou. The white tower stands on the verge of a precipice, and is 120 feet high. Near by is a lower tower, which led into the subterranean dungeons. The Duke of Milan was seized and secretly imprisoned here in one of the cages in 1500, where he lived for ten years. The famous historian Commynes died in one of them, and so on through a fearful list. Those iron dungeons were used as late as 1789, when their use was abolished by an edict.

In a way, as different as men's lives are the histories of these strange castles. Chinon has no tragedy, but it is richest of all in important historic events. It is now in almost complete ruins. None but an humble peasant can occupy the royal apartments; the rest is uninhabitable. It was long the residence of the Plantagenet

kings. Here Joan of Arc proved to the assembled people her divine inspiration by choosing the king from among his courtiers. The rock upon which the castle rests rises 300 feet above the river, and the extent of the ruins shows that it was doubtless once the greatest in France.

The Abbey Fontevrault, though not a castle, ranks as one in nearly every feature. It was founded in 1098 as a convent for both monks and nuns, the only one of its kind thus maintained in the world, and so remained for nine centuries. Strange to say, it was often the prison for renowned persons who were given to the Mother Superior for safe keeping. Among the many noted persons entombed there were Henry II., one of the greatest kings of England, with his wife, Eleanor, and their son, Richard Cœur de Lion.

Near the little village of Champtoie are the magnificent ruins of one of the most ancient castles in France. It was a feudal castle whose Lord Gilles de Retz, in the time of Charles VII., bears the history of having been the most frightful human monster of medieval history. He was a terror to the whole surrounding country and was by the people given the name of Barbe Bleu, or Bluebeard, the original of the story of that name. The story tellers all put a turban on his head and make a Turk of him, but the true original of the story lived on the banks of the Loire.

The origin of his atrocities appears to have been in the destruction of his physical constitution in early youth by extravagance and debauchery, which he sought to restore to strength by the practice of the black art. He had in his employ an Italian alchemist, who told him that his health could be restored only by bathing in fresh young

human blood. The chronicles of that time state that more than a hundred children and young women had disappeared from the neighborhood before the truth was known, when the fury of the people rose to such a height that an insurrection was organized to storm the castle and destroy it and its lord. The Duke of Brittany interfered and brought him to trial. The evidence was conclusive. He was found guilty and condemned, at which he confessed the full list of his monstrous crimes. He was burnt at Nantes in 1440. The peasants to this day regard the ruins with horror and shun them in terror because of the belief that it is haunted by the ghosts of the victims and that of the terrible Bluebeard.



CATACOMBS OF PARIS

The catacombs of the French capital are a wonderful and a weird sight, and one that is open to any member of the public who makes a written application to the proper municipal officer. Their historical origin is interesting, and aptly exemplifies the changes that time brings in its train. From a remote past down to the seventeenth century they were merely quarries whence stone was drawn, and drawn to keep pace with the growth of the city above them.

The natural consequence of this drain upon the vitals of the city's support was a subsidence, in 1774, which, by damaging property and bringing about numerous accidents, informed the public that some one must do something or that nobody would be left to do anything. In 1777 a still stronger hint from below roused the government to an activity which expended its

energy in supporting with piers and buttresses the most dangerous portions of the affected area. These works, continued from year to year, proved a fertile source of expense.

In 1784 the question arose as to the disposal of the relics of mortality which were to be removed from the disused Cemetery of the Innocents. It was suggested that the quarries should be still further strengthened, and rendered compact by their adoption as catacombs. The suggestion met with approval, was adopted, and the transfer of the vast accumulation of bones entered upon with all due precautions. It was thus that the quarries became the garner-room of the Destroyer; it was thus, as the various cemeteries within the city ceased to yawn for their dead, that they were made to yield up their silent tenants. In 1786 the catacombs were solemnly consecrated. At this period the bones and skulls were being cast down on the floors of the caverns and passages in great heaps, without any attempt at order or arrangement; nor was it till the year 1812 that the authorities commenced the work which has culminated in the present artistic presentment of that which once formed the framework of living thousands.

Come! we will descend together as two members of the public, and see a portion of this underground and silent world that extends its ramifications beneath 200 acres of Paris. We are in possession of our "permits," and according to direction find ourselves at the principal entrance on the right of the Place Denfert-Rochereau.

One o'clock strikes. The door guarding the entrance to the ninety steps that lead below swings open. Its harsh grating is the signal for a brisk fusillade of match-

firing reports. The matches are applied to the candles; a strong odor of tallow seethes through the mellow sunshine, and through its sickly fumes we commence to slowly advance. Already the leading file has vanished within the doorway, and as we in turn approach the orifice a dull roar pours sullenly out to meet us. Tramp, tramp, tramp—we have passed beneath the archway, we are descending the spiral of the stone staircase. The air is heavy with the clangor of ponderous footfalls, murky with candle smoke that veils with weird effect the flickering, draught-driven light. As far, and just so far, as we can see above and below us, all is in movement; dresses, coats, candles whirl slowly, uncertainly downwards. The very walls seem to writhe in the uncertain light, to mutter and moan with inarticulate voices.

Down, down, down! All are in the rock-home of death. A moment's pause, a silence falls on the chattering crowd. Then, affrighted with their second's fear, they sway onwards through a rocky gallery. Rock on either side of them, rock above them; here bare and arid, there slimy with oozing water and foul growths. The passage broadens out, it narrows, and ever and ever there is the black line on the roof that marks the road. Suddenly a black shadow on the left or to the right. The eye plunges into the depths of these side roads, and recoils aghast at their mysterious gloom.

The lights file on. Still, forward, the shadows to right and left grow in size; some have a sentry silently guarding their obscurity from rash obtrusion; where there is no sentry there is a chain. Suddenly the rocks on either hand contract, change color, and break out into the grue-

some design of a symmetrically built wall of bones and skulls. From the level of our heads down to the level of our feet, skull rests upon skull, and leans back against the myriad bones behind. The shivering candlelight falls with unequal rays upon the formal tiers; it flashes coldly upon the grinning teeth, penetrates the mortarless crannies of the wall, and ever shows bone of many shapes and curves. The designs in skull and bone become more complicated.

The walls become more lofty, rush from straight lines into curves, assume the form of chapels. Around and about you are skulls, skulls, skulls. But even as you dream in one of these chapels, a faint, prolonged rustle comes stealing to the ear, and vanishes mysteriously as it came. The guide catches an inquiring eye, and explains that it is the rats

moving. He makes the blood run cold with the horror of his account of those who have been lost in the catacombs and hunted to their death by the sharp-teethed rodents.

We grow thankful that, as two of the public, we move on and on to the exit at the Rue Dareau, and find there life and sun-

ing associations; none is so thickly haunted with memories of the past; none is tenanted by the ghosts of so brilliant a crowd of famous men and women. It is a document to which twenty kings have set their sign-manuals, a chronicle in stone of the history of France, a dumb yet eloquent preacher of the mutability of human greatness.

Successive sovereigns from 1137 to 1870, from Louis le Gros to Napoleon III.,



PALACE OF FONTAINEBLEAU.

have enriched it with memorials of their rule. Within its precincts, by ancient custom, the royal wives of monarchs have brought into the world the heirs to the throne. Upon its buildings the uncrowned queens of France, from Diane de Poitiers to Madame de Pompadour, have lavished their luxury, their caprice, and their extravagance. The ermine of Anne of Bretagne, the porcupine of Louis XII., the pierced swan of Claude of Lorraine, which are so conspicuous on the walls and ceilings of Blois, are absent from Fontainebleau.

Seven centuries of changing taste have



FONTAINEBLEAU

No public building in France appeals to the historical imagination more eloquently than the palace of Fontainebleau. None awakens so rich and varied a group of strik-

left their mark upon its walls. It is a mosaic of stone and colors, into which are dovetailed the various stages in the history and progress of French art. Upon its walls some of the greatest of French architects, sculptors and painters have inscribed their work. From Fontainebleau emanated the first great artistic movement in France.

Historically and artistically, Fontainebleau is the jewel of French palaces, and the brilliance of the gem is enhanced by the unrivaled beauty of the setting. The frame is worthy of the picture. The forest stands alone among the forests of France in its diversity. Every variety of tree, poplars and chestnuts, maple and birch, oaks and junipers, flourishes in abundance. The wild and savage scenery of *Salvator Rosa* alternates with the calm and peaceful landscape of *Claude Lorraine*.

Fontainebleau in the days of Louis VII. was a fortified castle, a gloomy keep occupying the site of the present Cour Ovale, flanked by towers, protected by lofty walls, strengthened by a moat, and approached by a drawbridge. Few traces remain of the early fortress, but the existing buildings were erected on its foundations, and its form is preserved in the irregular shape of the courtyard. Within the baily of the fortress stood the chapel of St. Saturnin, bishop and martyr of Tonlouse, finished, as the inscription in the subterranean crypt states, by Louis VII., in 1169. Thus the feudal stronghold of the Cour Ovale formed the nucleus round which gathered, at different epochs, the present magnificent and heterogeneous structure. Any one who passes from part to part of the great building, and asks himself, "What happened here?" "What king built this or that por-

tion of the palace?" "What effect did his life or death produce upon France?" will gain a truer and more real knowledge of the history of the country than can be derived from the reading of books.

It was to Fontainebleau that Philip Augustus returned from the Crusades, or in the intervals of the war which he waged against Richard Cœur de Lion. Here, in 1191, he celebrated Christmas in the company of a brilliant throng of nobles with splendid festivities, before he offered thanks for his return at the shrine of St. Denis. Here, six years later, he signed a charter which conveyed the heritage of Franchard to the monastery of St. Euverte of Orleans. The site of the lonely cave, hollowed in the rock, its floor worn by the knees of the hermits, who lived a life of prayer, surrounded by fierce beasts of prey or still more savage human beings, is now a cafe thronged with pleasure-seekers.

Many scenes in the life of St. Louis are associated with Fontainebleau. It was here that, in 1228, he confirmed the privileges of the University of Paris. Here, too, in 1259, believing himself to be at the point of death, he called his son to his bedside, and delivered to him one of those exhortations which Bossuet calls the sacred heirlooms of the children of St. Louis. "Son," said he, "I pray thee to make thyself beloved by the people of thy realm. For, verily, I had rather that a Scot should come out of Scotland, and rule the kingdom well and loyally, than that thou shouldst rule it ill and to evil report." The king was restored to health, and, in gratitude for his recovery, founded a hospital by the side of the castle, and within its walls, for the sick of the neighboring country.

It was in the castle of Fontainebleau that Charles V., surnamed the Wise, founded his famous library, and here, as tradition asserts, by paintings on its walls, Charles VII. commemorated his victories over the English. But from the death of Philip the Fair till the ascension of Francis I. the stream of history flowed in other channels, and Fontainebleau is associated with none of the great episodes in the struggle between the Burgundians and the Armagnacs, or between the French and the English. The exigencies of state policy led sovereign after sovereign to prefer the castle of Touraine.

Among the suite of apartments built by Louis XV., on the site of a gallery constructed in the reigns of Francis I. and Henry II., is the room in which Napoleon signed his abdication, on April 5, 1814. "The allied powers having proclaimed that the Emperor Napoleon is the sole obstacle to the re-establishment of the peace of Europe, the emperor, faithful to his oath, declares that he abandons for himself and for his heirs all claims upon the thrones of France and Italy, and that there is no personal sacrifice, including even that of his life, which he is not prepared to make in the interest of France." The writing-table on which this abdication was signed, and the pen with which he wrote his name, are preserved in the room.

With the farewell of Napoleon I. the historical charms of Fontainebleau come to an end.



BELGIUM'S GREAT TRADE

This little Latin state is one of the most prosperous countries in the world, although it has no ships to speak of, and one-fifth of

its food in cereals and meat is imported. In 1900 the foreign trade of Belgium amounted to nearly \$100 per inhabitant, against \$35 for Germany and \$90 for Great Britain. Her exports of hardware and textile goods alone have in one year been as high as \$75,000,000 from an area one-third the size of the state of Indiana, with a population of 7,000,000. One-third of these speak only French and one-third only Flemish.

Nearly the entire population is Roman Catholic, there being fewer than 10,000 Protestants and 4,000 Jews. However, not only is full religious liberty granted, but the ministers of all religions are assisted by the national treasury. In 1898, \$1,000,000 were given to the Roman Catholics, \$20,000 to the Protestants, and \$4,000 to the Jews.

Socialism has gathered great strength in Belgium, and many socialistic features of government have been adopted. Every year finds an increase in measures of national and municipal paternalism and the experiments have so far proven satisfactory.



HOLLAND'S ABANDONED CITIES

The quaint and primitive town of Zaandam, "beyond the dam," in its prosperous days was a town of 12,000 inhabitants, intersected by numerous canals, and the center of large shipbuilding operations. Holland was then "the King of the Seas," and hither came Peter the Great, Czar of all the Russias, to learn the trade of shipbuilding, in 1697. He worked incognito, under the registered name of Peter Michaelhoff. He lived by himself, preparing his own meals and doing his own washing,

in a hut of two rooms. The cottage, or hut, now leans in all directions, and the floor resembles the waves of the sea. It is bare of furniture, except such as the great Peter used, a bedstead, a table and two chairs.

But the walls of this historic hut, only ten by twelve, are covered with the names of visitors from all civilized nations. Over the old-fashioned chimney a marble tablet was placed by Alexander of Russia in 1814, with the inscription: "Alexander, to Peter the Great." The whole hut is now encased in a building, erected for its preservation by a former Queen of Holland, Anna Pavlovna, who was a Princess of Russia. But "Peter Michaelhoff," finding himself an object of too great curiosity at Zaandam, went to the shipyards at Amsterdam, which were enclosed by a high wall. He there completed his apprenticeship, and in off hours constructed with his own hands the model of a man-of-war, which he took with him to Russia as a model for the great Russian navy. Eighteen years after, he came back to Holland with his wife, the Czarina, to visit with her the shipyards where he had worked as a day laborer, and had lived upon his pay as "Peter Michaelhoff." The anniversary of this visit is still observed at Zaandam as a holiday; and in commemoration, the name of the town is written Saardam and Czardam.

And yet with all this historic association Zaandam is one of the Dead Cities of the Zuyder Zee. It is but a small town, if even such it may be called, with its detached cabins, painted bright green with red roofs, seen amidst scattered trees. Its canals are dry, and serve as roads; yet its cabins are said to contain china and old carved furniture fitted to delight the heart and excite the envy of a nineteenth century anti-

quarian, searching for decorative household treasures of the past.

Its four hundred windmills now make flaxseed oil, and their owners are city millionaires. But desolation reigns in Zaandam; the only life is in its oil-mills, bewildering and confusing in their turnings and twistings to the point of vertigo.

Alkmar, another of the "dead cities," is celebrated for its famous victory over the Spaniards in 1573—a victory that put fresh life into the Dutch cause, and was a turning-point in their favor. It was once a prosperous city, but is now only a well-kept village, celebrated for its cheese and wooded walks.

Broek, once the capital of North Holland, is now only "the cleanest village in the world." It is curious, interesting and clean, but the life has been washed out of it; its inhabitants seem turned to stone. The front doors of the one-story houses are never opened except for a marriage or a funeral, and the stillness of death is in its streets. Yet once across the threshold of these primitive homes, rare antique carved furniture, old china and Dutch curiosities crowd the "best room," while the curious old costumes of the few inhabitants have an enchantment all their own.

Mannikendam is another of the Dead Cities of the Zuyder Zee, and is more dead than any of the others. No living creature is to be seen along its brick-paved streets, not ever a dog or a cat. Not a door nor window of its red-painted houses, with green Venetian shutters, is open. It was once a flourishing city of commerce, one of the twenty great towns of Holland. Strangers seldom visit it now, for street after street, lined with closed houses, all seem to say, "We belong to a past age."

And it is true. The few descendants that remain of the thrifty Dutch of Monnikendam care as little for the modern world as the world cares for them.

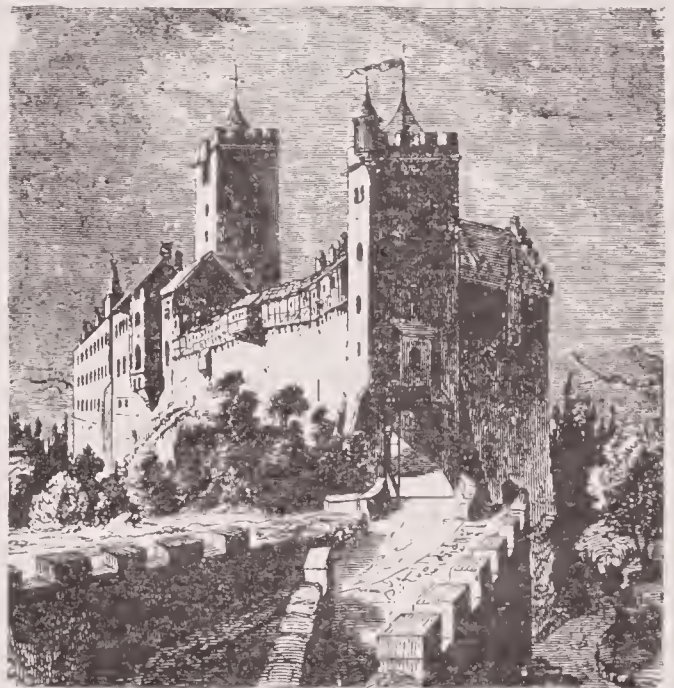


MARTIN LUTHER'S PRISON, WARTBURG CASTLE

There is no German, however little informed as to the history of his country, whose patriotic sentiments are not stirred when speaking or hearing of Wartburg Castle. There are castles in Germany with scenery around them as lovely; the legends connected with Wartburg Castle are but of transitory interest, and memorable only so far as giving to us vivid glimpses into the superstitious character of those times; to many people, particularly to practical Americans, who possess nothing of the kind in their history, they may seem ludicrous even when considered as mere improbable stories; and the moral which is attached to many of them remains unappreciated or undiscovered. Luther found an asylum at Cobourg Castle as well, and there wrote the most celebrated of his hymns, "Ein' feste Burg ist unser Gott—A castle strong is our Lord God"; in local historical reminiscences and mediæval adornments the Castle of Nuremberg is to the Southern Germans, and Marienburg Castle, in East Prussia, to North Germans, undoubtedly dearer, because nearer and more directly associated with the histories of their native provinces.

"The cause of this prominent and remarkable fact," says the venerable poet and historian Storch, "is that every German of the present day, be he aware or unconscious of the special acts in its history, considers and venerates the Wartburg as Ger-

many's sole national sacred relic, as the stronghold from which radiated the light of German mind, as the hallowed spot whence sprang the liberty of German thought, as the battle-field in the victorious and untiring struggles of German genius. That which makes of the German a real German, which constitutes him a soldier of and gives him a foremost place among the pioneers of civilization, namely, the precision and the clearness of German knowledge, and the courage to declare and maintain the truth of knowledge in the face of



WARTBURG CASTLE—WHERE MARTIN LUTHER WAS IMPRISONED.

all the world, this characteristic feature of Germanism, we not only find symbolically indicated but even distinctly manifest in the past history of Wartburg Castle."

The bold reformer, Dr. Martinus Luther, had just stood before Charles V., that young but mightiest of German emperors since the days of Charlemagne. He had spoken before the assembled magnates of the empire at Worms, consisting of the Emperor, the Archduke Ferdinand, six

electors, twenty-four dukes, seven margraves, thirty bishops and prelates, and princes, counts, lords and ambassadors without number, on April 4, 1521. "And if there were at Worms as many devils as there are tiles on the roofs of its houses, thither I will go," he had replied to the entreaties of his anxious friends, who justly feared for his life. And when he entered the glittering hall where the Diet held its sessions, when stepping through the ante-chambers filled with men-at-arms, just at the entrance of the great hall, the old veteran general, George of Frundsburg, the Imperial Chief of the Landsknechts, while encouragingly patting his shoulders, had said: "Little monk, little monk, thou walkest to-day upon a difficult and dangerous road, such as I, though often standing before mighty dangers and in the turmoils of deadly strife, have never as yet marched upon; but if thy cause be just, fear thee not, for God will not then abandon thee!" He had just stood but not trembled before the mighty Emperor, and had answered the demand to recant by those memorable words, "Unless I be refuted by Scripture or the most unanswerable arguments, I cannot and will not recant. Here I stand; I cannot do otherwise; may God help me, Amen."

The friends of Luther were in sore distress for his safety; above all, the Elector, Frederick the Wise, of Saxony, his most powerful patron and friend. Such was the fear of the Emperor's authority, however, that the Elector even did not wish to be personally concerned in any plan for the protection and safekeeping of Luther; nor did he wish to know where he was to be brought into security; "that with reasonable truth I may be able to excuse my-

self of any knowledge of these things," he remarked to Spalatin, his private secretary and court-preacher. Luther had already at Worms received some mysterious hints as to the projected undertaking to carry off his person and protect him against the consequence of the Emperor's decree.

His return from the Imperial Diet was like a triumphal march. Alttersfeld in Hesse, the Abbot with the dignitaries of that ancient ecclesiastical city, received him outside the gates, banquetted him and insisted upon his preaching before the assembled people, although this was against the strict Imperial prohibition. At Eisenach the burghers turned out en masse to welcome him. In the same night, at Erfurt, while he slept tranquilly in "his dear town," the students, his youthful admirers, revolted because the Dean of the Cloister of St. Severus had pushed Dr. John Drach, a tutor at Erfurt University, and one of the Reformer's adherents, from the steps of the high altar. On the day following, the 2d of May, Luther preached at Eisenach before his traveling companions, who were now to leave him, with the exception of the doctor of theology, Nicholas von Amsdorf, to return to the town of Wittenberg by way of Gotha; while Luther turned aside to Moehra Village, near Salzungen, to visit his kindred, where he met his old grandmother for the last time, as well as his uncle, Heinz Luther, a simple-hearted peasant.

When he arrived he met his brother Jacob quite unexpectedly. On the 4th of May, after having preached under an old linden-tree to his kindred and humble peasant friends, he continued his journey, accompanied by his brother Jacob and the inhabitants of Moehra Village, as far as

Waltershausen. Dr. Myconius, the pastor of Gotha, is also said to have been with him. Thus, in a simple country wagon they passed Waldfisch Village, then the larger one of Schweina, through which they drove between four and five o'clock in the afternoon. They had now arrived at the foot of the steep hill near Altenstein Castle, where Luther made the driver slacken the pace of the horses, and requested his friends and kinsfolk to return. It was already dusk when they entered into the high-road near the ruined chapel overlooking the lonely narrow pass through which the road wound. There suddenly broke from the sombre shades of the woods a horseman in armor, with lowered visor and lance at a charge, followed by four heavily armed companions. Brother Jacob was the first to jump from the wagon and escape (little aid, our valorous brother, he was!), while one of the assailants seized the horses' bridle-reins and roughly called upon the driver to know "what sort of people he had in his wagon?" at the same time striking him with his bow so severely that the poor fellow fell beneath the feet of the horses. In the meantime two of the knights had informed themselves as to the person of Luther, and one, putting the drawn bow upon his breast, demanded his surrender. The companions of Luther remaining with him, Doctors Myconius and Amsdorf, implored the knights that he be treated mercifully; but Luther, who evidently understood the situation perfectly, whispered to his friends, "*Confide, amici nostri sunt*"—"Be of good cheer; they are our friends." Luther was now taken from the wagon, his monk's cowl was torn off him, a "*gepner*"—knight's cloak—put on instead, he was led into the woods and put

on a horse by the friendly kidnapers who were rescuing him.

While in wild anxiety, Brother Jacob hastened back to Waltershausen to spread the sorrowful news of Luther's capture, Amsdorf and Myconius journeyed to the same town in a much easier frame of mind; and the knights with Luther penetrated deeper into the wilds of the forest, where they bound another man upon a horse so as to make it appear as if a batch of dangerous criminals had been captured by them. They now made a considerable detour toward the foot of the Jusel Mountain, the highest peak of the range, in order to deceive the wood-cutters and charcoal-burners as to their real destination, and they arrived at Wartburg Castle shortly before midnight. It was in the night from Saturday to Sunday that Luther first set foot into the now memorable chamber. "I've ridden nigh fifteen miles, I am tired and weary," he afterwards wrote to friend Amsdorf. To deceive the inmates of the castle, who had crowded together to see the late unexpected arrival, he was roughly spoken to, pushed into his cell and the door locked upon him.

The secret of his capture and imprisonment was so well kept that one hundred years elapsed ere the circumstances, as here related, were generally known among the people.

Luther's residence at Wartburg was not without interest. The Governor of the castle, a nobleman of ancient lineage and immense wealth and full of pride, became his friend; the Governor's haughty eye soon felt the influence of that "*falcon-eye*," as Erasmus of Rotterdam forcibly describes it. Luther was thirty-eight years of age at that time and still unmarried; he had

not yet found his Catharine of Bohra, and he looked quite different from the oil-painting by Lucas Cranach, which was taken in later life, and according to which we generally fancy him, when conjuring his picture to our mind's eye, a portly, stout, well-to-do old gentleman, of serene and happy countenance, with a double chin.

His chief work, as we know, was at Wartburg, the translation of the Scriptures. But he neither there translated the entire Bible, as is often supposed, nor did he employ much time in what he translated. He soon perceived the difficulty of translating the Old Testament by himself, and wrote to Amsdorf on the 14th of January, 1522: "Without your aid I cannot enter upon the Old." The New Testament, as this day used in the Protestant Churches of Germany, was translated by Luther in the short space of two months.



THE KREMLIN OF MOSCOW

The Kremlin is a colossal volume of Russian history, with many chapters and a long index of pages. It is a record of memorable events extending through centuries. It is the heart and soul of Russia. It is the great central fortress of this mightiest empire of ancient or modern times. It is the throne of the Emperors. Here they have been crowned for ages. They would not dare to be crowned elsewhere. Here their thrones and crowns, and imperial regalia are deposited for safe-keeping for the admiration of posterity. The Kremlin is the grand sanctuary of religion. It is the center of Russian cathedrals and the consecrated residence of the Holy Synod of the Greek Church and her Metropolitan Bishops. Here they perform

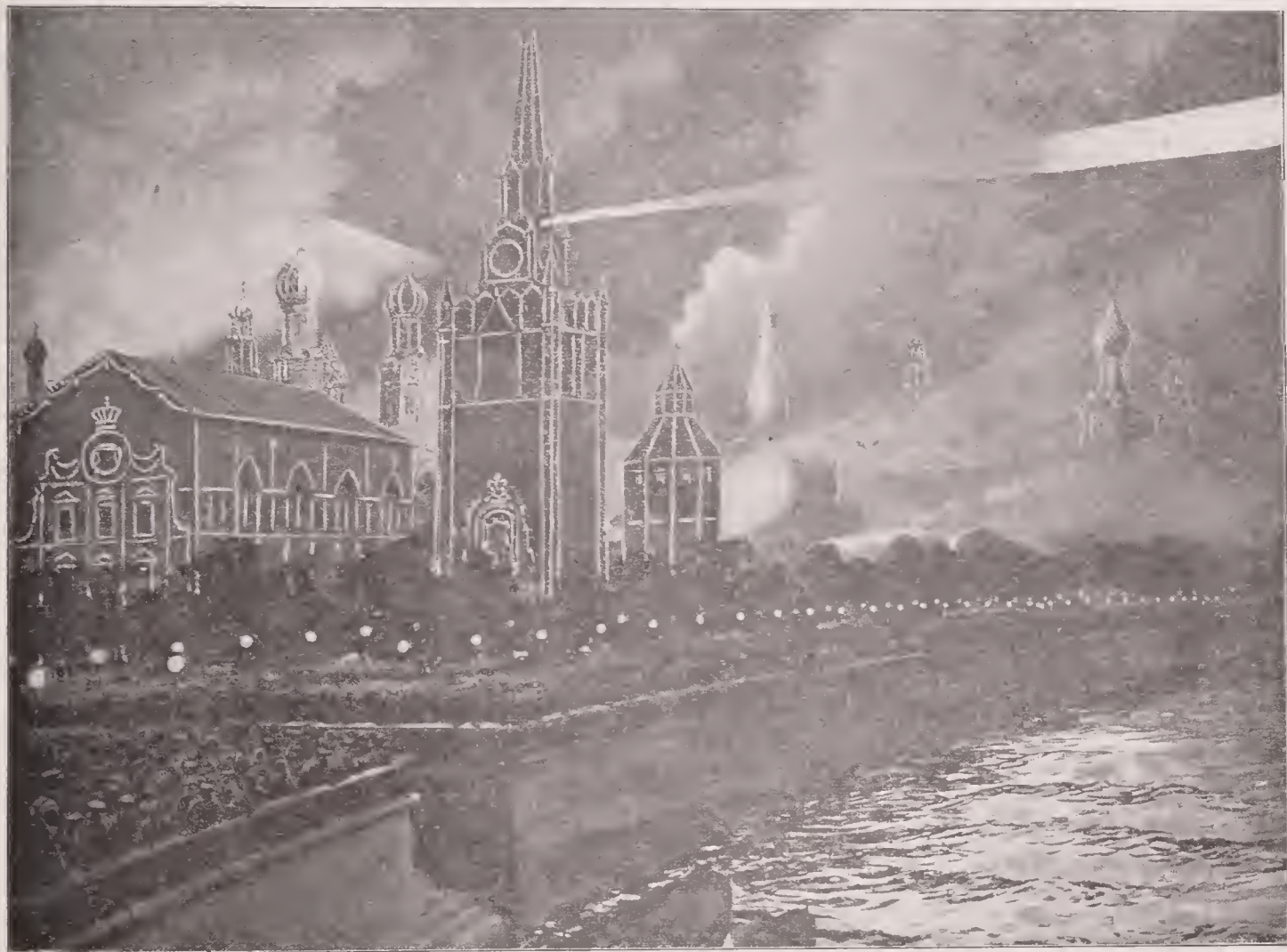
the coronation ceremonies and anoint the sovereigns of Russia with holy oil; and on these occasions the imperial court of Russia exhibits scenes of superlative magnificence, upon jeweled thrones, with diamond crowns, and precious stones of inestimable value.

The Kremlin is the pride of Moscow, the holy city of all Russia. It was the chosen abode of the old Muscovite Princes, the long residence of the old Tartar sovereigns. It is the sacred Alcazar of the Slavonians, the great Northern Acropolis, the far-famed Alhambra of the Russians. And it is the venerated mausoleum of the imperial family from Ivan the Terrible down to Peter the Great. Here are the tombs of the Patriarchs taking their long slumbers with the mighty monarchs whom they crowned. It includes all that is most precious and sacred to the Russian race. In viewing this colossal collection of palaces, cathedrals and towers, the spectator is supposed to stand upon the south bank of the river Moskva, above the massive stone bridge, with its seven arches. The Moskva is here two hundred yards in width. Immediately behind the spectator on the broad street where he stands, is a long range of high buildings on the same side of the river, and about one-third of Moscow. The current flows to the right along the walls of the Kremlin, leaving a broad carriage-way between the walls and the river. The finest view of the Kremlin is obtained from the Moskvietiskir bridge.

It derives its name from the Tartar word *Krem*, signifying fortress. It is a tall city in the center of Moscow. It stands on a hill. It is elevated like a mighty salver, laden and filled with palaces and cathedrals, high above its surroundings. It is

encircled by castellated walls a mile and a half in extent. These walls vary from twelve to sixteen feet thick, and from thirty to fifty feet high, surmounted with sixty-one turrets, and having five gates of entrance. It dates from 1367. Within these walls are contained all the most historically important buildings of Moscow; the holiest churches, with the tombs of the ancient Czars, patriarchs and metropolitans—the imperial palaces, ancient and modern, celebrated convents, the arsenal, senate-house and architectural memorials of every period of Russian history. All the monarchs have felt it a duty to adorn and improve the Kremlin by adding some monument. It has thirty-two churches and cathedrals, and

one hundred and seventy towers and cupolas in gold and green colors, glittering with star spangles. The churches vary in the number of cupolas. Some have three, others four and some have thirteen cupolas, which are symbolical. Three cupolas represent the Trinity. Five cupolas indicate Christ with the four Evangelists, and thirteen, Christ and the twelve Apostles. One of the most singular and wonderful buildings is the cathedral of Vasili Blagennoi, or the church of St. Basil. It has twenty towers and domes. They are of different shapes and sizes, and painted in every possible color. Historians affirm that the origin of this singular cathedral was a whim of Ivan the Terrible, to try how many dis-



NIGHT ILLUMINATION OF THE KREMLIN AT MOSCOW.
This was the magnificent scene at the coronation of the Czar.

tinnet chapels could be erected under one roof, in such a manner that divine service could be performed simultaneously in all without interference one with another. This terrible monarch, it is said, was so much pleased with the edifice, that he caused the eyes of the architect to be put out to prevent him from planning another like it.

Of the five gates of the Kremlin, we only stop to describe one, the Spass Vorota, the gate of the Redeemer, near the St. Basil Cathedral. Over this gate is a picture of the Savior under glass. It is held in greatest reverence by the Russians. This gate forms a passage through the tower of about twenty paces. Every one, monarch, high or low, must take off his hat here and keep it off till he passes through. Its sacred reputation has continued for centuries. The Tartars could not pass it. Miraculous clouds, it is said, veiled it from view. There is a sort of legend that the French army could not force an entrance by this gate. They attempted to blow open the gate with cannon; but the powder would not burn. They built a fire over the touch-hole; but the powder exploded the wrong way, and killed the gunners, so it is said.

Let us next ascend the lofty tower of Ivan. It is the highest tower in Moscow, exceeding two hundred feet. It has numerous stories or belfries, affording fine views as the visitor ascends the staircase. Close behind this tower, and near the entrance, stands the monster bell of Moscow, the greatest the world has seen. It has excited the wonder of ages. It is called the Czar Kolokol or King of Bells. It is twenty-one feet high and twenty-two in circumference. Its weight is over seventy tons. It is said to be worth, as old metal, more than half a

million dollars. It fell from the tower in 1737, and broke out a piece six feet long and three feet wide.

We ascend to the first story, in which is hung a solitary bell, weighing sixty-four tons. It requires the strength of three men to toll it three times a year. Ascending the upper belfries, we find more than forty bells in this tower, diminishing in size as we ascend. On Easter Eve a death-like silence reigns in all the streets, till on a sudden, at midnight, the thunders of the guns of the Kremlin burst forth, and the clangor of all the church bells of Moscow, many hundreds in number, are heard resounding over the city, while countless thousands of the inhabitants come forth, and with one voice all repeat the words, "Christ is risen," and all evince great joy at the glad tidings.

We reach the summit of the tower, and look abroad over the most magnificent scene in Europe. Clustered around the tower upon which we stand are thirty-two churches, including the cathedrals within the walls of the Kremlin. We look down upon them all,—domes, towers, golden spires and imperial palaces. Beyond the walls of the Kremlin the eye wanders over the whole city of Moscow with its five hundred churches, and countless domes of green and red, starred with gold, glittering spires pointing upward in rich profusion over the city landscape far and near. What mighty and memorable events, and what tragic scenes have occurred and been witnessed within the purview of this high tower! Fearful calamities have visited Moscow along the line of its history. Six times it has been devastated and nearly destroyed by fire or sword. Tamerlane, the Eastern Destroyer, began the list of fearful trage-

dies and ravished it. Next it fell into the hands of the Tartars, who sacked it, and put many of the inhabitants to the sword. Again in 1536 it was nearly consumed by fire, and two thousand of the inhabitants perished in the flames. In 1571, the Tartars fired the suburbs, and a furious wind drove the flames into the city, and not less than 100,000 persons perished by fire or sword. In 1611 a large portion of the city was again destroyed by fire.

The terrible scenes in the modern burning of Moscow by order of Count Rostophin are still fresh on the pages of history. It was a fearful sacrifice to destroy this sacred city of the Russians by their own hands. But it sealed the doom of Napoleon and his grand army. This massive old tower has, however, stood firm amid all these scenes of blood and fire. Turn your eye down now upon the ground and look along the walls near this tower, and you may count 876 cannon which once belonged to the grand army of France, which were left, or lost, or captured, or buried in the snows of Russia on that terrible retreat.

It is not strange that Moscow and the Kremlin hold such a place of reverence and affection in the hearts of true Russians. From Sparrow Hills, three miles away, Napoleon caught the first view of Moscow in all its pride, grandeur and magnificence; so, from these same hills, a few days after, he took a sad, lingering look at the same city enveloped in smoking ruins.

But Moscow has arisen, liked the fabled Phoenix, from its ashes, and now appears far more magnificent than before, as the great commercial metropolis of Russia. It is the truly Russian city, little modified by European influence, and far more interesting to the stranger than St. Petersburg.

HUNGARIAN GIPSIES

Inhabitants of all countries and natives of none, these children of nature call themselves Rommany. Until George Barrow enlightened us as to the habits and dialects of these wanderers, it was believed that their language was a mere incongruous polyglot of every language under the sun, consisting of inversions and contortions of words and slang expressions. This has all been shown to be erroneous, though many of our own slang words come from the Rommany. "Pal" is pure Rommany for brother. The half-contemptuous expressions of "Fiddle-sticks" and "Fiddle-dee" distinctly come from the same language, and "Bosh" is Rommany for fiddle.

They are all more or less musical, though in England rather less; in truth, the English gipsy seems to be disappearing entirely, emigrating perchance, or dying out. Except, as far as can be ascertained, in Hungary and Transylvania, they have no fixed habitations, or legitimate callings, living in most countries on the "glorious gospel of haphazard" principle, in a half-hearted sort of way, upon their wits, their cunning and fortune-telling. They scarcely ever resort to violence, being of a too lethargic temperament to exert themselves about anything except when they grow jealous, and then their action is swift, fierce, and often fatal. Gipsies come of a very ancient Indian stock, so ancient indeed as to defy all attempts to trace their origin, and were unquestionably the victims of some dire vengeance, and, most likely, were dispossessed of all their belongings and lands by some other ancient race, even to their belief in themselves and their god or gods, for now they neither

worship nor believe in anything, though they are quite prepared to call themselves Christians, and will pretend to embrace the religion of the people who permit them to settle in their midst. But in reality they remain heathen, cherishing the traditions of the fire worshippers, which in all likelihood they were at an early stage themselves. They will allow a priest or clergyman to baptize one of their children, but the rite has no significance for them until the eldest of the clan has held the infant

over a large open fire. Then is the child admitted to the community.

For centuries they have wandered as outcasts and aliens; they have no recognized state, no laws, no civilization; and, as already indicated, no religion, the one exception to prove the rule being the gipsies of Hungary, with an apparent religion, rather than a real one. The gipsies are at home only in the open air, and their country is the whole wide, wide world. For everywhere Nature is the same eternal,

powerful, sublime, inexhaustible mother, and in winter or in summer, in north or south, only the direst necessity would bring one of these sons of the wilderness under any roof, that is, of the ordinary built house.

In most countries the gipsies are only tolerated because they cannot very well be got rid of, but in Hungary, if not actually welcomed with open arms, they have, after long settlement (if such nomads can be called settlers anywhere), become a recognized, and indeed very important, element of the community. It was the great musician Franz Liszt who first brought the gipsies of his native country, with their marvelous musical natures, to the notice of



MISS STONE AFTER HER RELEASE.

The ransomed missionaries after their captors had left them, were sheltered in the home of a native preacher, where their American friends found them.

the public, and it was, as he acknowledged himself, their influence that had such a marked effect upon the style that he adopted, and tended to develop that genius that made him famous. In return he wrote a history of his favorite people, and set to music many hundreds of songs depicting their life and legends as written by the poets.



THE REFERENDUM OF SWITZERLAND

Fifty thousand voters in Switzerland, by signing a petition, can have any law that has been passed by their assembly or legislature submitted to the people for ratification or rejection. This system, known as the referendum, went into effect in 1874 and has been followed satisfactorily ever since. In the census of 1901 there were 728,681 qualified voters, but at the elections there are rarely more than half that number of accepted votes cast.

The town meetings of public school districts in the rural parts of the United States are the nearest form we have of the plebiscite or referendum, of which the law in Switzerland is the best example in national affairs. In favor of the plebiscite, as the vote of the people on legislation is called, the following arguments have been mentioned:

It is a calm appeal to the will of the people, "yes or no" on a given piece of legislation. In other words it is making a jury of a community or nation. It arouses the interest of voters in measures of public policy rather than in political bosses and politicians. It increases the stability of legislation, for acts of legislation are not

so likely to be passed and then repealed as often happens in representative bodies. It inculcates patriotism of the highest form and makes jobbery in legislation well-nigh impossible.

In the cantons or counties of Switzerland the number of signatures on a petition necessary to compel a measure being submitted to a vote of the people varies from 500 in Zug to 6,000 in Vaud. All these petitions are limited as to time, after the publication of an act passed by the legislative body. The time for the filing of a petition varies from four to six weeks. If the assembly is doubtful as to how a proposed piece of legislation will be received, it may itself refer the given act to a vote of the people.

The initiative, or origination of proposed legislation by the people, has also been successfully tried in Switzerland. This is a kind of legalized extension of the ancient right of petition, wherein the demands of the petition are not discretionary but mandatory. The number of persons who may present a demand for the consideration of proposed legislation varies from a single person in Zurich to 12,000 in Bern. It would seem likely that where any single individual could alone compel a plebiscite or referendum vote on any proposition, there would be a deluge of such demands. But in the twenty years following the adoption of this plan in Zurich, only twenty-two such demands were made and fifteen were rejected by the majority vote of the people.

The constitutional law of Switzerland provides that petitions to the number required may compel a vote even for the dissolution of the assembly and council, the council of seven members being practically

the same as the president and cabinet of the United States.



GENEVA AND ITS LAKE

The water front of the beautiful Swiss city of Geneva, which faces the lake of the same name, offers one of the most picturesque views to be found in interior Europe. Geneva is a city of 30,000 inhabitants, lying at the foot of the lake, and divided into two parts by the swift and rushing River Rhone. The favorite promenade, the Mont Blanc Bridge, crosses the river and connects the two parts of the city. Broad quays lined with handsome buildings, many of which are the popular tourist hotels, face the river and lake. A wooded park and a sea wall of masonry are favored resorts for the traveler, who from here obtains a beautiful view of Mont Blanc and

the lake itself. Considerable commerce is transacted on the blue waters of the lake, and the peculiarly-rigged sailing boats which ply between the city and the neighboring villages on the shore help to enliven the scene. Here it was that Calvin preached and Rousseau was born. Voltaire, Byron, Goethe and the Empress Josephine were among those whose fame is identified with this favored place of their residence. The lake is the largest in Switzerland, being about fifty by nine miles and 1,230 feet above the sea level. It is in the form of a half moon. The water is deep blue and contains but few fish. It never freezes over, and has mysterious rises and falls, strong currents and water spouts. Excellent steamboats serve to carry the traveler back and forth throughout the length of the lake, and give access thus to some of the most delightful resorts of Switzerland.



WATER FRONT OF THE CITY OF GENEVA, LAKE GENEVA, SWITZERLAND.

THE VATICAN

The Vatican, which is one of the seven hills of old Rome, has always retained its ancient name, and in the ages when the papal power was at its height, this name was almost as significant and imposing to the Christian world as that of Rome itself had been to the Pagan nations. The excommunications and anathemas—"the thunders of the Vatican"—made emperors and kings tremble on their thrones, and often shook Europe from one end to the other. Princes and people looked with equal awe to the ecclesiastical palace on the hill, where spiritual arms, with the cross, the signet-ring, and the pen, wielded by a few infirm old men, decided the fate of "powers and dominions." After a long waning, the mighty temporal strength of the Vatican disappeared, but still that immortal hill has a lasting hold on the veneration of mankind.

The palace of the Vatican, which covers a good part of the hill, has few external features to recommend it to the lover of architecture, but taken as a mass, its prodigious size and solidity are imposing. It occupies a space which is 1,200 feet in length, and about 1,000 feet in breadth. It is, however, rather an assemblage of buildings grouped and connected together, than one palace, and the component parts have been erected at different periods, and by very different architects.

Although the building itself has not much architectural beauty, its grand and capital accessory has a great deal. This is the staircase which forms the principal entrance, and connects the Vatican with the noble portico of St. Peter's. It springs boldly from the base of the equestrian

statue of Constantine, and in four majestic flights of marble steps, adorned with a double row of Ionic pillars, it reaches the threshold of the grand entrance hall. It is the work of Bernini, and taken altogether it is probably the most magnificent staircase in the world. From the entrance hall we may pass directly into many historic and magnificent rooms.

The history of the Bible, from the crea-

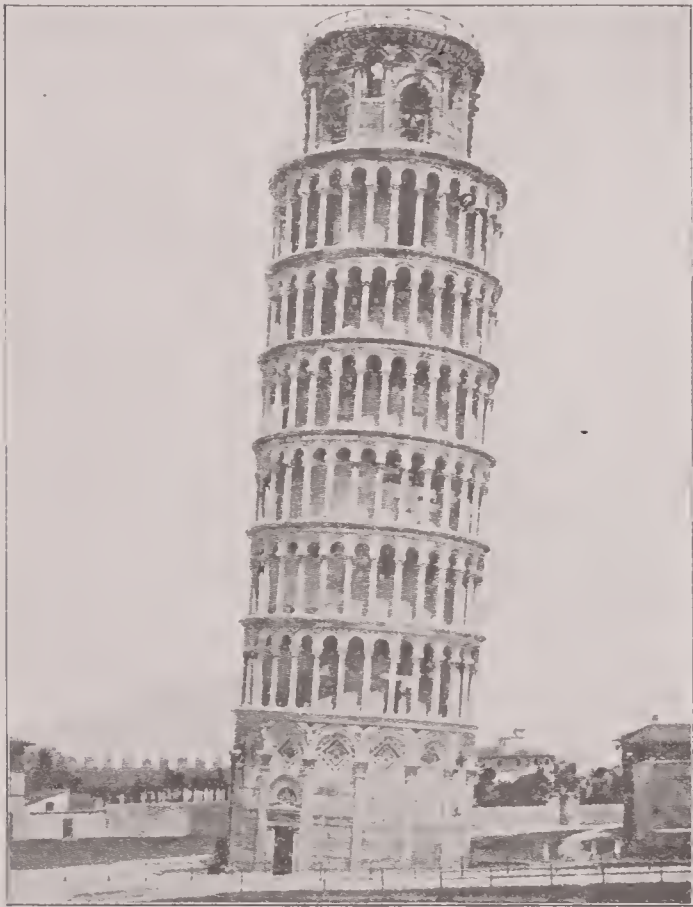


IN THE VATICAN GARDENS.

tion of the world, is painted on the arched ceilings of Raphael's galleries. From one of these galleries a door opens into the Camere di Raffaello, which are covered with the frescoes of that greatest of masters. These rooms in themselves present a great and wonderful school of painting. They are totally unfurnished—the cabinet-maker and the upholsterer had no

business here—the soul and hand of D'Urbino fills and beautifies them. Among the grand subjects he has treated in these chambers are "Pope Leo and Attila," the "Judgment of Solomon," the "Coronation of Charlemagne," and the glorious "School of Athens."

Crossing the court of San Damaso, and some chapels and halls which form the state apartments of the Vatican, the visitor comes to a vast well-lighted gallery, at one



THE LEANING TOWER OF PISA, ITALY.

side of which an iron door admits him into the Vatican Library, a magnificent range of buildings covered with paintings throughout, and more than 1,000 feet long. Several apartments branch off from this grand line; the Stanza de Papiri, or room of manuscripts written on Egyptian papyrus before the introduction of paper, is covered with frescoes by Mengs. With a happy appropriateness, the designs,

decorations, and marbles in this beautiful room are all in the Egyptian style.

Not far from the library are magnificent halls and galleries of the Belvedere, which name has been given to the only true, the only "glorious Apollo" (in sculpture)—the matchless Apollo di Belvedere. This far-extending museum is lined with marbles, paved with ancient and modern mosaics, and filled with statues, vases, candelabra, tombs, altars, medallions and medals. Specimens of Egyptian, Etruscan, Grecian and Roman antiquities are all found here; and never surely was there a shelter built by modern hands so worthy of being a lodging to these ancient gems and treasures.



THE LEANING TOWER OF PISA

The Leaning Tower of Pisa is perhaps one of the most familiar architectural structures in the world to all who have read any of the pictorial literature of travel. So unique is it in its construction and in its position that it has been conspicuous and famous for many centuries. The tower was built for a belfry, or campanile, near the cathedral of the Italian city of Pisa. It was begun in 1174 and finished nearly 200 years later, in 1350. It is 179 feet high, in eight stories, surrounded by colonnades, and contains seven bells. It is fourteen feet out of the perpendicular, but is absolutely stable, amply complying with the inflexible rule of physics that "the center of gravity must fall within the base" of any object that is to maintain its position. It has been disputed whether the builders intended the tower to lean in this fashion, or found that it settled to this extent in spite of their

desire, but the latter contention is generally accepted. Pisa is a quiet and beautiful town of 50,000 inhabitants, with a history which includes a Roman conquest, a rivalry of Venice and Genoa in the Middle Ages, and a defeat of the Saracens in many naval battles. It was adorned with temples by Augustus and Hadrian, and now contains architectural and artistic beauties in addition to the Leaning Tower, sufficient to attract hosts of visitors every year.



CORK IN PORTUGAL AND SPAIN

The maritime county in the province of Munster, Ireland, derived its name from the Irish word *Corroch*, meaning swamp, but the substance of the same name, with which we stop bottles, derives its name from the Latin word *cortex*, meaning bark. Thus we have the same word applied to widely different objects, having an equally wide derivation.

The soft bark known as cork is taken from a species of oak that grows abundantly in Portugal, Spain and Italy. During July and August, after the tree is fifteen years old, the bark is removed and thereafter every three years. In other species of oak, if a simple ring is cut through the bark, around the tree in the spring, its death at once begins and is complete in a few weeks, but the cork tree, completely denuded of its bark every three years, will live at least 150 years. But this is agreeable to the nature of the tree, for if this bark is not removed artificially it will, on maturity, dry into fine bits and fall off like scaly bark hickories.

There are scattering groups of cork trees

growing throughout northern Africa, about equal in quality to those in Italy, and thus somewhat inferior to those of Portugal, where the best cork is obtained. In 1859, an attempt was made to start cork groves in the southern United States. The trees



BOTANICAL GARDENS, LISBON, PORTUGAL.

grew unusually thrifty, but the cork proved to be of poor quality.

In Catalonia, Estramadura and Barcelona, Spain, there are a thousand square miles of cork forests growing densely, to the average height of fifty feet. The in-

dustry in Catalonia employs 10,000 persons, each of whom in the course of a year gathers an average of a ton of cork. Where it is so abundant, it is in almost universal use. In Spain, it is made into all sorts of culinary utensils, it lines floors and walks, it is made into mattings of various kinds, and even used as pillows. In Italy, it is made into crosses, images and sandals. In Turkey, where the cork is of a harder quality, it is used in making cabins and is in

common use to make coffins for the peasants. In Algeria and Morocco, it affords the material for house furniture, plates, drinking vessels, tubs, armor plating and boats.

In Portugal there are 34,000 square miles of cork groves. As these forests are in the hands of private monopolies, the government furnishes no statistics. However, it is known that the export of cork from Portugal amounts to an annual average of about 25,000 tons of the rough bark, and nearly 3,000 tons of manufactured articles.



GIBRALTAR

Gibraltar proper occupies a bold, rocky peninsula which guards the passage between the Atlantic Ocean and the Mediterranean. It is a favorite military and naval station, wherein officers of both services can resign for the season their professional cares for lighter joys. Its works of defense, its bomb-proof batteries and fortresses, heavily armed, more resemble the bulwarks of nature than those by the hand of man. They are well grouped together, even if in a small area, because Gibraltar in no case exceeds three-quarters of a mile in breadth. The rock rises abruptly from the low, sandy, peninsula-like isthmus, to about 1,400 feet above the level of the sea. From its summit a view of unique sublimity is obtained. It can only be appreciated when seen. The mighty Mediterranean Sea stretches away in the background, alike shadowy and grand in scenic beauty, steamers and shipping ever traversing its waters. In another direction the Atlantic Ocean and expanded water of the Bay of



THE FAMED STAIRS OF CAPRI, ITALY.

Biscay, washing the shores of Spain, are prominent features.

Gibraltar was known to the Greeks and Romans as Calpe or Abyla. The strip of land near Ceuta, across the straits, was named Abyla. For many centuries they formed the renowned pillars of Hercules, the then limit of ocean enterprise and commerce. Its strategical value to England is of paramount importance, being really the key of the Mediterranean, along which the merchants of the world pass upon their lawful commerce.

The ocean's surfy, slow, deep, mellow voice, full of awe and mystery, breaks night and day against the rocks, moaning, as it were, over the dead it holds in its bosom, for the sea is the largest of all cemeteries, and its slumberers sleep without monuments. In other graveyards distinction is shown between the grave of the peer and that of the peasant, but in the sea and ocean, closely encircling Gibraltar, the same waves roll over all, and the same requiem is by the minstrelsy of the ocean sung in their honor. The same storm beats, and the same sun shines over their remains, but their graves are unmarked.

It is the general and popular belief that Gibraltar is an impregnable fortress, but grave doubts have arisen during the last twenty-five years as to whether "The Rock" is really the impenetrable quadrilateral it is generally supposed to be. All political parties of England appear to be agreed that if there are any defects they should be rectified, hence the action of the government in sending out the Duke of Cambridge to inspect and report upon the necessary requirements, the absolute necessary strength of the garrison, and other material and detailed matter.

Gibraltar has been the theatre of many sieges. The first appears to have taken place in 1309, when Alonzo Perez de Guzman took possession of it for Ferdinand IV. of Spain. The real value of the Rock was evidently discovered and appreciated by the Moors in the eighth century, when they erected a fortress upon it. In 1315 there was a second siege, but the invaders were beaten off; however, in 1333 Vasco Perez lost Gibraltar. A fourth siege to get it back took place in vain in 1344, and in 1349 there was a fifth siege. The sixth resulted in Gibraltar being transferred from the hands of the king of Morocco to those of Yussef III. of Grenada. The seventh siege by the Spanish Count Niebla Enrico de Guzman was disastrous to the besiegers. In 1462 an eighth siege brought Gibraltar once more under Christian rule. By a ninth siege the Duke of Medina Sidonia contrived to get himself, son and heir, created perpetual governors of the Rock. In 1501 the fortress was formally incorporated with the domains of the crown of Spain, and there was a tenth siege in 1506, by the Duke Don Juan, trying to recover possession.

The pirates of Algiers made a furious attack on the Rock in 1540, the object being to recover it for Mahomet, but the besiegers were repulsed after a bitter conflict, and immediate steps were taken to strengthen the works of nature by those of art, so that the Rock eventually became a model first-class fortress. During the war of the Spanish succession, the combined Dutch and English fleets under Sir George Rook captured the fortress. In 1704 Spain closely invested Gibraltar both by sea and land, but after a bitter six months' siege the invaders retired. The apes of Bar-

bary still find protection under the British flag, and are often seen from the signal-station, the only place in Europe where such animals may be seen at large.



THE ISLAND OF CRETE

Better known in classic history as Candia, and famous for its hundred cities, its labyrinth, the legend of the Minotaur and Mount Ida, the island of Crete has witnessed more of war than perhaps any other spot on the globe. The first to take it from the Greeks were the Saracens in 823, but they lost it to its original owners again in 961. Venice, then in the zenith of her power, purchased it in 1204, the inhabitants, however, rising in rebellion, and only being subdued in 1364. After standing a siege of twenty-four years, during which some 300,000 men perished, it surrendered to the Turks in 1669, and since then, with the exception of ten years dating from 1830, when it was ceded to Egypt, it has been, in spite of desperate struggles for freedom, ruled by the Sultans.

A persecution of Christians in 1859 by the Moslems brought about a long and determined struggle for independence, and in 1866 the Cretan General Assembly proclaimed the abolition of Turkish authority. This struggle continued with varying success until 1869, when the Provisional Government surrendered and Omar Fenizi was appointed Governor by the Sultan. Another insurrection took place in 1877, and early in 1878 union with Greece was proclaimed. The Berlin treaty, by declaring for the enforcement of legal and political reforms, quieted matters for a time, but in

1884 another rising against Moslem rule took place, order not being restored, and then only by the mediation of the Powers, until 1887.

Since then various small risings have taken place, only to be sternly repressed with the greatest cruelty and bloodshed by the Turks. The most notable revolt was that of 1895, which involved Greece in a war with Turkey. The sympathy of the Greeks with their persecuted brethren was such that the Greek "irregulars" along the frontier of Macedonia became involved in numerous attacks on the Turkish troops stationed along the line, which resulted in bringing on a war disastrous to the Greeks.

The Sultan agreed to govern Crete according to the requirements of the powers, and a plan was reached whereby it was believed that the utmost liberty would be secured by the Christian Greeks under Turkish rule.



THE STRANGE SEA MILLS OF CEPHALONIA, IN GREECE

When the waves of the sea cannot enter into the caverns remote from the shore, except by narrow channels, it often happens that a rivulet of soft water regularly flows toward the interior of the land without ever returning to the ocean. This strange fact, which may seem at first sight a reversal of the laws of nature, may be observed at various points on the coast of calcareous countries, and especially on the coasts of Greece and the neighboring islands. Near Argostoli, a commercial town in the island of Cephalonia, four little torrents of sea water, rolling on an average fifty-five gallons of water per second, penetrate into the fissures of the cliffs, flow rap-

idly among the blocks that are scattered over the rocky bed, and gradually disappear in the crevices of the soil.

Two of these water courses are sufficiently powerful to turn throughout the year the wheels of two mills constructed by an enterprising Englishman. Though the subterranean cavities of Argostoli are in constant communication with the sea, and the entrance to the canals is carefully freed from the seaweed that could obstruct the passage, or at least retard the current, the waters are not the same height in the grottoes as in the neighboring gulf. This is because the calcareous rocks of Cephalonia, dried on the surface by the sea breeze and the heat of the sun, are pierced and cracked throughout by innumerable crevices, which are so many flues aiding the circulation of the air and the evaporation of the hidden moisture.

The boundaries of this influx have never been definitely determined, but it certainly extends along the coast for nearly half a mile. At all points between the two mills, and for an unknown distance beyond each, the water is everywhere percolating through the cracks and fissures of the limestone and sinking into the earth. The openings in the sea bottom around the point are, no doubt, mainly closed by weeds, gravel, etc., yet no inconsiderable amount of water must find its way to these mysterious depths through such an extent

of beach, lying on a rock that is practically as porous as a sieve; and since this condition may prevail for a long distance from the shore, where the pressure would tend to increase the flow, we may reasonably assume the quantity of water absorbed outside of the mills as undoubtedly greater than that needed to run them.

If we assume that each grist mill would require five horse power to operate it, and



ITALIAN FIELD LABORERS AT THE DINNER HOUR.

that the head of water actually used was about three feet, we must have a flow of at least 1,000 cubic feet per minute, or 2,000 per minute for the two mills; and we must double this amount to get even an approximate estimate of the magnitude of the inverted river at Argostoli. This assumption makes the daily consumption of water nearly 6,000,000 and the annual consumption over 2,000,000,000 cubic feet. If we imagine a cavern below we must give it generous proportions, as 2,000,000,000 cubic feet of water would fill a chamber about five miles long, 1,000 feet wide, and

75 feet deep. Or, if the water runs into a fissure, say 10 feet wide, it must be about 10 miles long and 4,000 feet deep to hold one year's influx at this point.

No explanation of this phenomenon heretofore suggested is even measurably satisfactory. It cannot be connected in any way with tidal phenomena, because this part of the Mediterranean is almost tideless, and there is nothing periodic in the flow of the water into the land. That the water is simply filling a system of fissures and caverns in the earth is clearly inadmissible in view of the well-established facts. The flow of water into the land has certainly been uninterrupted since 1833. The supply of water is exhaustless, and the rate of downpour is limited only by the capacity of the fissures. The present rate of flow, or anything approaching it, continued for a century, would give a total volume of water so prodigious as to far exceed the capacity of any known caverns.

The force of this objection is augmented by the consideration that caverns other than fissures must have been formed by solution of the rocks and have thus required for their formation a volume of water many times greater than that required to fill them. Furthermore, it is virtually an axiom in geology that all cavities in the earth below the drainage level of the district, and especially below sea level, except possibly those due to recent, sudden, and extreme rifting, must be permanently and continuously full of water, and certainly it is hardly conceivable that fracture fissures, developed at the surface as mere cracks, could require centuries for their filling with the sea pouring into them.

None of the suggested modifications of the cavern theory seems to be worthy of

serious consideration. We cannot suppose that the water flows into caverns and disappears by evaporation or absorption. Both of these processes below a very moderate depth would necessarily be extremely slow, and the former would gradually fill the caverns with salt. Nor can we follow the supposition that an earthquake has at some period opened a communication between the sea and the region of volcanic fire, and that the water, being there converted into steam, is afterward condensed in its upward course and forms those hot springs which exist in various parts of Greece.

Equally objectionable is the view that the water is absorbed at great depths by molten masses. Volcanic phenomena are wholly wanting in this part of Greece; that is, there are no active, recently active, or extinct volcanoes, nor, so far as we can learn, any geologically recent volcanic rocks. The great crater of Santorin is three hundred miles distant, while Cephalonia and the neighboring mainland consist of secondary and tertiary strata, overlying ancient crystalline rocks.

The rejection of all these hypotheses forces us to the conclusion that in some way the water must return to the surface. A circulation, due exclusively to hydrostatic pressure, is manifestly impossible, unless, indeed, it should issue in the basin of the Dead Sea, a full thousand miles distant, since the water starts downward from the sea level. Still less can we suppose that it would rise in the form of saline springs on the land.

It has occurred to mind, however, that in the subterranean heat we have an adequate cause of aqueous circulation. The temperature of the ground increases downward, and it certainly is not a violent hy-

pothesis that the water gains access to a system of fissures traversing a notable range of temperature. In this connection it may be noted that the conditions are favorable to profound fissuring; for Cephalonia, like the rest of Greece, is distinctly a seismic region—earthquakes, often of destructive severity, being of annual and almost monthly occurrence, and the prevailing rock formation is the massive cretaceous limestone, some thousands of feet in thickness.



LIFE IN A TURKISH HAREM

Romance, mystery and pictures of revolting moral misery have been almost the sole source of information regarding the peculiar home life of the people whom we chiefly know as the unspeakable Turk.

Our own customs are, of course, our own measures of morality, and anything different must be very bad. However, if it is enough to live a satisfied life, we must admit that the inmates of the harem live well. They are wholly absorbed, as nuns in a convent in the child-like faith and religious sentiment of their career. Strange to say, more than ninety-five per cent of the inmates of the harems of the rich and powerful are Circassians. These white women of Circassia look upon an entrance into a Turkish harem as the height of ambition. In truth, it is a

great advance to them, both socially and materially. They believe themselves far superior in caste to any Christian lady that ever lived. The Circassian is first a slave in the harem, but at any time she may become the wife of the master and thus be raised to such superiority over others that the slave is always treated with as much deference and respect as if she were already mistress of the house.

It causes no comment for the wife of a rich pacha to rise on the entrance of a slave and humbly kiss her hand. This is because the wife was once in an inferior position to what the slave now is, and had always been well treated by the slave thus honored. As an inferior slave may suddenly be raised to high position, her former superiors kiss the hem of her garment without jealousy or envy, for to them it is all fate.

The great national powers, by compact with the Turkish government, forbade the traffic in slaves a few years ago, and since



CONSTANTINOPLE—YILDIZ PALACE AND MOSQUE.

then the number of Circassians in the harem has somewhat lessened. Before this, when a young man became twenty years of age, his father went to the slave market and brought home a few slaves, from which the son selected a wife. Then the young man in the course of the year bought two or three more as slaves of his wife. These, with the wife, were in the same position as the slaves of the father. At the death of the father, his wives went out of the house to homes of their own, with their children, and the son's wife became the head of the house, while her slaves became odalisques, that is inferior wives.

The odalisques rank much lower than their children in the household, but higher than their slaves. Should they have no children, or should their children die, they rank no higher than slaves, and can expect no different treatment. In that case, at the death of their husband, they are either pensioned, on barely enough to keep them, or they are married to any old servant who will keep them, or they are sold as slaves and begin again the life of a slave, with its prospects.

The entire life of the odalisque is spent in sewing, gossiping with her slaves and visitors, and caring for her children. The house of the harem has its walled gardens



THE FAVORITE OF THE HAREM.

and yards, and of warm evenings the family gathers in a group on the grass under the trees, sing songs and listen to the wild stories of some old woman. These evening scenes may be visited by the brothers, cousins, nephews or uncles of the head of the family, but by no others.

The fidelity of slaves to the odalisque is a remarkably developed trait. "I have eaten her bread and salt and I can not leave her," is the sentiment expressed. Bread and salt are sacred symbols, and no greater curse can be pronounced in a household than for the master to say, "May my bread and salt rise against you."



EGYPT AS IT IS TO-DAY

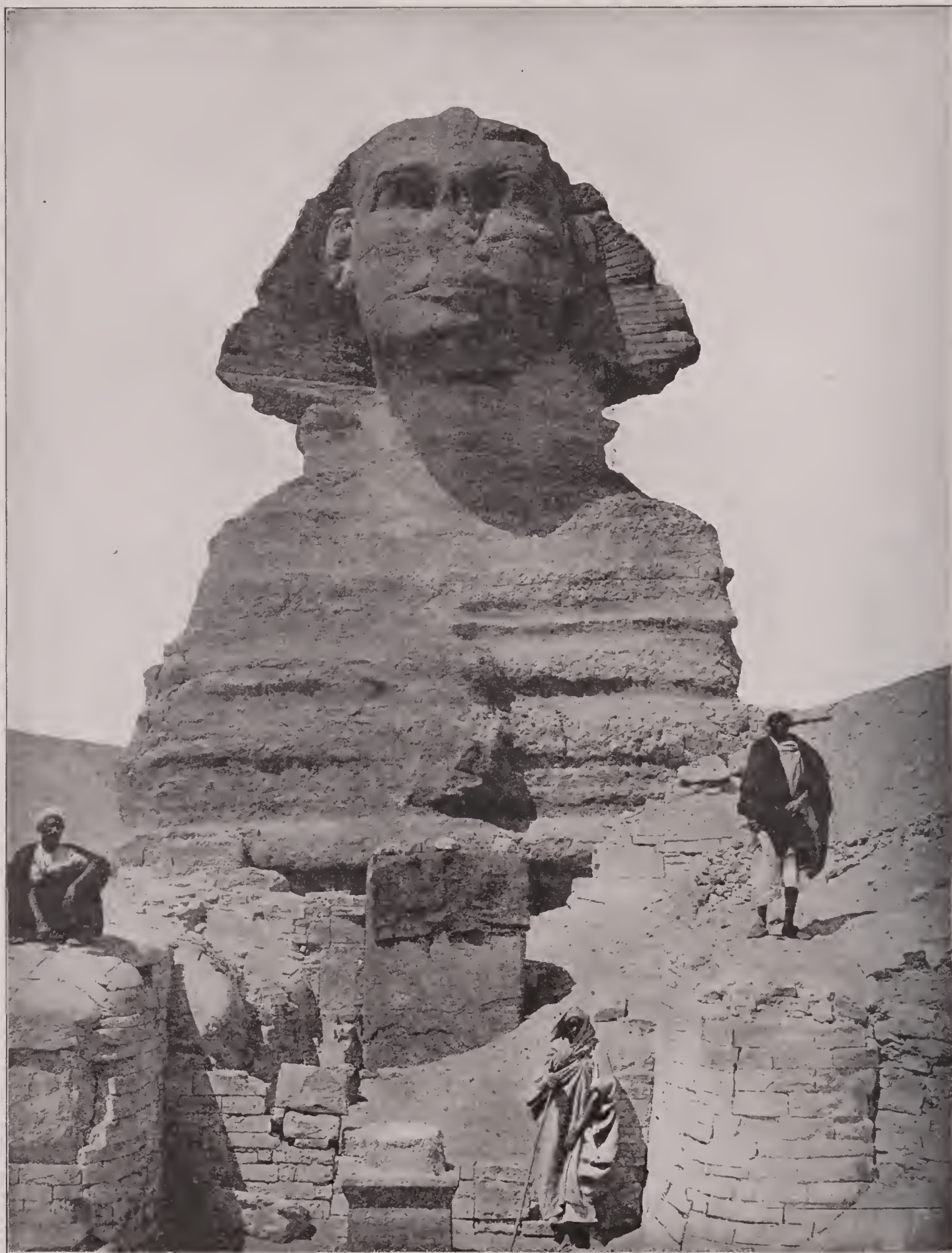
Great as it was in the early history of civilization, Egypt to-day has but little prominence in the affairs of the world. Even now its chief interest to us lies in the past. Luxor, Karnac, Memphis, the Nile, the Pyramids, the Sphinx and the Desert—these are the names that are significant to us in their suggestion of a historic past and a proud civilization. And yet even in Egypt the influence of the Industrial Age is felt and a new regime seems to be beginning. To-day, Alexandria, the ancient city, is an important modern port, largely rebuilt since the bombardment, twenty years ago, and the center of a large export and import trade. The Suez Canal turned

the tide of travel between the Orient and the Occident across the corner of this ancient realm, where the Red Sea and the Mediterranean come nearest together. This has brought hosts of travelers into Egypt whose journeys otherwise would have taken the wide detour from Europe around South Africa, to reach India, Australia or the Far East.

Here is another evidence of the far-reaching effect of the industrial influence upon whatever country it touches. The construction of the Suez Canal made it necessary that the European Powers, who shared in its expense and whose vessels made use of it, should preserve the peace and order of the neighboring country. And so first by formal treaty and afterward by virtual occupation, England obtained dominance in the affairs of Egypt, which is nominally a state tributary to Turkey, and governed by its own Khedive. The Turkish influence, therefore, being virtually nullified in Egypt, and the British influ-



IN THE SHADOW OF THE GREAT PYRAMID.



~ THE GREAT SPHINX, NEAR THE PYRAMIDS, CAIRO, EGYPT, ~

ence having become so strong, Egypt is enjoying peace, order, commercial prosperity and industrial development to a degree that it has never known before. Modern innovations have been introduced into the Egyptian cities almost as freely as in Western Europe. It is not necessary now to patronize the clamorous donkey boys to reach the ancient remains of the tombs of the Pha-

raohs, for an electric trolley line speeds the stranger, from Cairo swiftly across the desert to the very base of the Sphinx and the great pyramids themselves. It is not yet reported that an elevator is running to the top of the pyramid of Cheops, but we do not know what may hap-



EGYPTIAN VILLAGE ON THE UPPER NILE.



CAMEL RACE IN SOUTHERN EGYPT.

pen. Passenger steamers ply up and down the Nile, and the products of that fertile valley, still irrigated by the annual overflow, as it was 5,000 years ago, enter the markets of Europe in competition with our own wheat, corn and cotton. Railways extend far southward along the Nile, into the heart of the continent, and it is no longer to be doubted that within a few years there will be direct connection from North to South Africa by way of the Cape to Cairo Railway.



RECENT DISCOVERIES IN EGYPTIAN ANTIQUITIES

It is difficult to realize that only five or six years ago criticism, so-called, was still assuring us that Menes, the founder of the united monarchy of Egypt, and his immediate ancestors were "mythical" and "fabulous." Now we know almost as much about them and the people over whom they ruled as we do about the Pha-raohs of the fourth dynasty. Art was far

advanced; the system of hieroglyphic writing had long since been perfected, and a "hieratic" or running hand had even been formed out of it. The jeweler's art had already reached a high state of perfection; a gold cylinder of a Babylonian type has been found by Dr. Reisner with the name of Aha, or Menes, upon it, and in one of the Abydos tombs four exquisitely wrought bracelets have been brought to light, the alternating gold and turquoise plaques of one of which are inscribed with the same name. The tombs themselves are vast and stately structures, more especially that of Den, or Esaphaes, which was paved with huge slabs of granite from Assuan.

Intercourse must have been carried on with all parts of the known world. The gold, which contains a little silver, came, according to Dr. Gladstone's analysis, from

Asia Minor; the vases of obsidian, fragments of which have been found in the tomb of Menes himself, from the Island of Melos in the Aegean Sea. There are shells from the Red Sea, and indications of the use of the incense that was brought from southern Arabia, and the coast of Somaliland, while the seal cylinder and the employment of clay as a writing material imply Babylonian influence. Indeed, the beads of lapis-lazuli which help to form one of the bracelets may have been imported from the mountains of Persia.

Egypt was thus already connected with the rest of the civilized world both by land and by sea. A few miles to the north of Abydos, near the village of Mahasna, the great brick tombs of two of the earliest kings of the third dynasty have been discovered by Mr. Garstang. The largest of



PYRAMID OF CHEOPS OR GREAT PYRAMID, NEAR CAIRO, EGYPT.

Contains 4,000,000 tons of stone and is 450 feet in height. Built 2100 B. C., requiring the labor of 100,000 men for twenty years. Was the tomb of Cheops, an Egyptian Monarch.

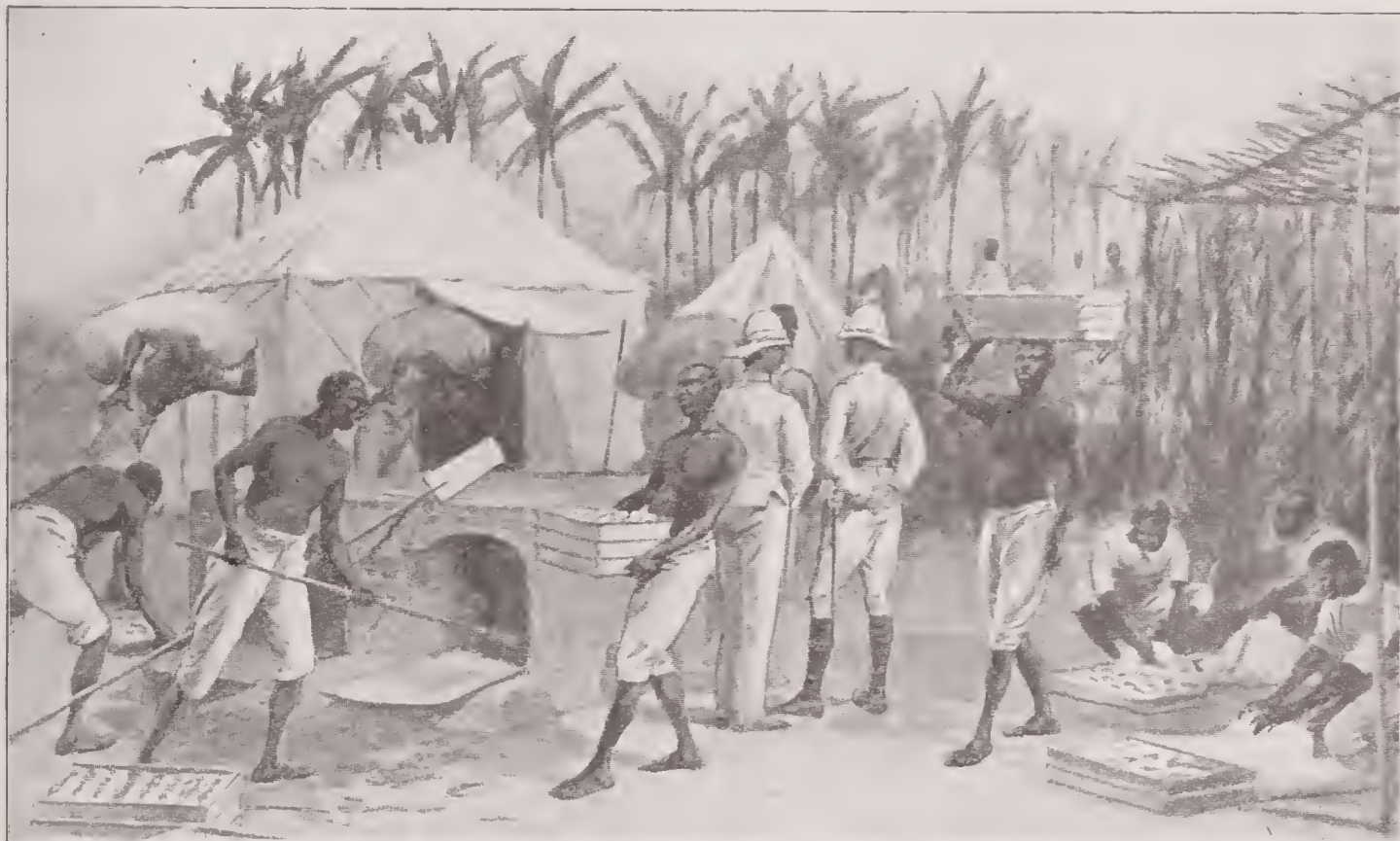
them is thirty feet above the surface of the ground and nearly seventy feet below it. The eighteen chambers which the explorer discovered here are approached by an arched passage and staircase which runs down through the middle of the edifice, from its top to its bottom. Huge portcullises of granite, let down from the openings in the brick roof, close the passage and

by means of a dike which Mariette identified with that of Koshesha.

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THE GREAT PYRAMIDS OF EGYPT

The Pyramids of Gizeh are all that remain of any of the Seven Wonders of the



BAKING BREAD FOR THE BRITISH ARMY ON THE NILE, UPPER EGYPT.

cut off the approach to the chambers. The sepulcher is what an old English writer would have called "magnifical," and testifies to a fact which is being impressed upon us by other recent discoveries, that the greatest architectural works of Egypt belong to what has hitherto been regarded as the beginning of its history. There is no longer any reason to question the Greek record that Menes diverted the Nile from its former channel under the Libyan hills,

Ancient World and they were old before any of the others had been thought of. In the time of Moses they were already ancient monuments, old almost beyond any of the authentic traditions of the times. They even then belonged to the times of an Ancient Egypt. Ever since the Israelites were in bondage to the Pharaohs, the minds of curious investigators have been busy with speculation as to why they were ever erected. Within the last century the

greatest number of persons have busied themselves with the puzzle, and it is yet unsolved.

Extensive researches and elaborate arguments have been used to show that they had been erected as barriers against shifting sands, as parts of a mechanism for filtering Nile water, as monuments commemorating the deluge, as a means of em-

press of the seasons, as a demonstration of the quadrature of the circle, as a commemoration of the long reigns of certain great kings, and as the tombs of the members of great dynasties. The latter is now the most generally accepted theory. A tradition that can be traced no farther back than the middle ages represents them as the granaries of Joseph. Pliny, who died in



THE SLAVE MARKET IN MOROCCO.

bodying in imperishable stone the mathematical and religious symbols of the world, as a measure of planetary distances, as a permanent standard of weights and measures, as monuments to monotheism, as prophecies of the birth of Christ, as a mathematical prophecy of the Second Advent measuring in numbers of inches the year 1882, as a record of their latitude, longitude, and date of beginning construction, as vast sundials used to note the prog-

ress of the seasons, as a demonstration of the quadrature of the circle, as a commemoration of the long reigns of certain great kings, and as the tombs of the members of great dynasties. The latter is now the most generally accepted theory. A tradition that can be traced no farther back than the middle ages represents them as the granaries of Joseph. Pliny, who died in

Herodotus, born 484 years before Christ, carefully examined the pyramids and gave the theory almost unanimously approved by modern scholarship, that they were built as the tombs for the kings of reigning dynasties. At the time of Herodotus there remained enough of the causeways or embankments upon which as inclined planes the great stones were dragged on rollers to their places, that Herodotus was able to put on record the method by which the pyramids were built, otherwise that process would now be as much a mystery as the purpose of these vast stone structures. Herodotus regarded these great causeways as objects of wonder almost equal to the pyramids themselves. According to his story there yet remained parts of these causeways in some places sixty feet wide and fifty feet in height. At that time the whole surface of the pyramids was covered with casings of cement, upon which were engraved or impressed hieroglyphics, giving these vast structures the appearance of having been chiseled smooth out of a single mountain of stone.

Thus is the idea suggested that perhaps the monuments were not only designed as the tombs of dynasties of kings but that the outside surface was designed to be a great library of history, or perhaps tablets for the engrossing of the law.

A French pilgrim to Egypt in 1395 found the dismantling of Cheops only about half done, and as late as 1638 most of the casing on Khafra Pyramid was yet untouched. An Arabian writer of the thirteenth century says that if the inscriptions on these casings were copied they would fill more than ten thousand pages. But these have all disappeared because of the ignorant vandalism of the Egyptian govern-

ments of the middle ages, excepting a few inscriptions copied by early pilgrims. Thus perished what might have been a complete history of the civilized world for unknown periods that were centuries prior to the birth of Moses.



THE TROGLODYTES OF AFRICA

The Troglodytes, or cliff and cave dwellers, of Africa are in the line of caravan travel, and are visited by these freight trains of the African desert. No outside influence has been able, however, to wean them from their ancient habits, their antique garb and their peculiar manner of living. So far as is known, the manners and customs of the Troglodytes have not changed since Bible times, and any one coming upon a group of these people in the present day, and comparing their appearance with descriptions extant that some historians have regarded as fabulous, will see that they are precisely the same now as they were many centuries ago.

A Troglodyte city is the most curious dwelling place in the world. From the exterior it presents the aspect of a Roman circus. The habitations are built in layers one above the other, and form a circular wall with a single entrance from the outside. All the doors of the houses open on the interior of the circular city. Each habitation has a door and a window. To get to them you climb a flight of steps cut in the wall, which brings you to the lower layer of houses. If you wish to go higher you climb another pair of steps to the houses above, and from here to the third row, if you are visiting some one living on the top of the pile. The doors are all fas-

tened with the most primitive lock that is turned by means of a wooden key.

Besides providing protection from their enemy, the sun, the circular habitation with the dead walls outside forms a strong fortress to guard the inhabitants from the attacks of neighboring tribes. In these more peaceful days, however, they have no such fear before them, and so they use the walled city mostly for the storing of crops, while they live in holes dug in the ground within the walls, and frequently change their posi-

tion in search of pasture for their animals.

The age of the cities is immense. The exact date when they were built is unknown, but it is believed that they antedate the birth of Christ. The people are peaceably disposed, in which phase of character they are superior to most other natives of northern Africa. They are intelligent and hard working, tending their flocks and farming their land with patient energy. The approach to their country is so difficult and dangerous, on account of the

frightful gorges it is necessary to traverse, and the risk of being overcome by the deadly sirocco, that the interesting people have been disturbed but little by Europeans.



LIBERIA, THE AMERICAN COLONY IN AFRICA

Lying between the fifth and eighth degrees of north latitude on the west coast of Africa is the little negro republic of Liberia. Its coast line is about three hundred miles, and its domain extends two hundred and fifty miles into the interior, so that its territory includes, perhaps, 75,000 square miles. It owes its existence to good men in America, both north



CAMPAIGNING IN CENTRAL AFRICA.
Native troops in British service crossing a swamp in the jungle.

and south, who many years ago felt that the freed people of the United States should have a place in the land of their fathers, where they could have the opportunity and satisfaction of building a nation of their own, which should demonstrate the capacity of the negro for nation building, and also open the way for his having a share in the civilization and redemption of the African continent.

There are now in the republic about 24,000 American-Liberians, speaking, of course, the English language; and perhaps 1,000,000 native Africans. The former are emigrants from the United States, or their descendants; and the latter are made up of various tribes of aborigines, speaking many dialects, acknowledging the sovereignty of the republic, but as a whole living in barbarism, as their fathers before them have done for many centuries. The form of government is modeled after that of the United States, and only negroes can own land, become citizens or hold office. A few thousand natives have become civilized and are a part of the nation. For twenty-five years Liberia was a colony, under the immediate direction of the colonization societies; but in 1847 the nation was formed and received the friendly recognition and good will of other nations. Liberia, Santo Domingo and Haiti are the only nations in the world controlled entirely by negroes.

To say that the hopes of the friends of the negro as a nation builder have been realized during the past fifty years in Liberia would not be true. On the other hand, to accept the uncharitable and unkind criticisms of the struggling republic, which are heard along the coast from many traders and travelers, and often reiterated

in Europe and America, would be doing great injustice to the people of Liberia. When we consider the difficulties which these people have had to meet in a new, and, to many, a hostile climate, their lack of wealth and experience in government, surrounded and permeated by multitudes of barbarous heathen, and subjected constantly to the uncharitable criticism of white traders and travelers, the marvel is that so much in the way of efficient government and advance in social conditions has been accomplished. True, their national domain, rich in minerals and agricultural possibilities, has not even been explored; but it is also true that, until within a very few years, but little advance has been made by other nations on either coast of the continent in extending practical and efficient government among the natives of the interior.



PYGMIES IN CENTRAL AFRICA

Away back in the days when most of the world was unknown, instead of being mostly known as it is now, the geographers making their maps used to decorate the outlying portions with all sorts of strange and fabulous figures. Probably they would not have claimed to believe that the giants and the dwarfs, the headless men and the men with one eye in the middle of their foreheads, the unicorns and the centaurs and all the rest of the monsters, really lived there. Even today we are very prone to imagine all sorts of mysterious things in the lands that have never been visited, although very likely if we were to go there we would find things quite as natural as they are here. But that was the way the ancient geographers displayed their ignorance, and their



OSTRICHES IN SOUTH AFRICA. ONE YEAR'S CROP ON A LARGE FARM.

acceptance of all sorts of traditions and travelers' tales that circulated from mouth to mouth very freely. Even the stories of Gullivers travels, with his dwarfs and giants and talking horses, found believers, where, on the other hand, the stories of Marco Polo, Sir John Mandeville, and other earliest travelers to the Orient, who reported things which are now known to be mostly true, were hardly believed at all.

Strangely enough, there are discoveries made at times, with the advance of exploration in the present day, which go far to verify some of the most extravagant stories of the past. Africa has done much to justify some of these old-fashioned myths. In Africa, for instance, was found the rhinoceros, which, with its single horn, is a clumsy sort of substitute for the unicorn of the ancients. In Africa, too, have been discovered races of man extremely backward in their development, and at least two tribes which are actual pygmies, to justify the old stories of the country of the dwarfs. It is in the great forests of the Congo River in Central Africa that these most peculiar races have been found. These pygmies were probably well known to the ancient Egyptian slave-traders, who journeyed up the Nile in ancient days to return with treasures and curious specimens and wonderful stories. Herodotus wrote about the pygmies and their fights with cranes, but the story has been believed entirely mythological, until the discovery of ostriches and these very dwarfs has given justification to the ancient classic writer. Sir Harry H. Johnston, the governor of British East Africa, who has described these African tribes most interestingly, suggests that from the mischievous actions of such dwarfs as these may easily have come the stories of brownies and goblins in our own fairy tales. He found two varieties of the pygmies, one with reddish and yellowish brown skin and a tendency to red in the hair of the head, and the other a black-skinned type with entirely black hair. The latter are slightly taller than the others. The tallest specimen measured by the explorer was about five feet in height, but the average height for the man was four feet, seven inches, and for the woman four feet, two inches. Several of the men were only four feet, two

inches in height, and several of the women were four feet. The nose and the lips are very different in shape from those of the ordinary negro types, the upper lip being long and straight and the nose having very little bridge. The chin is very much receding, the neck is short, and the head rather sunk between the shoulders. The legs are short in proportion to the body and the feet are inclined to turn in. Some of the dwarfs have quite long beards. They seldom wear anything in the way of ornament and in the forests they go about naked.

These Congo pygmies are very shy, and avoid contact with travelers through their country. They keep no domestic animals nor do they cultivate the ground, but live entirely by hunting with bows and arrows or snares. Their huts are about four feet high and of about the same diameter, built of branches stuck into the ground and bent over into a semicircle. The hut is thatched with large leaves and a small hole is left at the side through which the pygmy crawls in to lie on his bed of leaves, which is the only piece of furniture.

Stanley found some of these dwarfs in his journey through the Congo forests, and agrees with Sir Harry Johnston in the description. It seems that the little fellows have no language of their own, but talk more or less imperfectly the language of whatever tribe of negroes happens to be their nearest neighbors. The white travelers who have visited them say that, although they are absolutely savage in their natural life, yet they possess quicker intelligence than the ordinary negroes and learn languages easier. The foreign travelers declare that they are most interesting people, fond of singing and dancing, with music of their own that is distinctly melodious,

and a drollery of action which makes them generally entertaining. It remains now for Africa to yield a race of giants to complete the record of marvels which the continent has produced.



WHO ARE THE BOERS?

The Dutch were not in the first instance the discoverers of the Cape of Good Hope. The old Portuguese navigators were the first to brave the terrors of the Stormy Cape, as they called it. In 1486 Bartholomew Diaz doubled the Cape, and pushed his way beyond the present site of Port Elizabeth. In 1497 that great sailor, Vasco da Gama, passed the Cape, and penetrated by sea as far to the eastward as the Mozambique coast. Although the early navigators occasionally touched at the Cape on their way to the Indies, there seems to have been no regular settlement there until well into the seventeenth century. In 1591 Captain James Lancaster, with an English squadron, visited Table Bay. In 1595 four Dutch vessels, the first fleet to cast anchor in these waters, touched at Mossel Bay, a little to the east of the Cape. From this time fleets of the various nations were in the habit of calling at the Cape of Good Hope for rest and refreshment, obtaining oxen and sheep from the Hottentot aborigines, and picking up wild fowl, fish and green herbage.

In 1652 the Dutch East India Company finally took possession of the Cape, and founded a settlement there. Jan Van Riebeeck landed with a number of colonists, and at once set vigorously to work to establish the foundations of Dutch supremacy in this quarter of the globe.



BOER PRISONERS OF WAR IN INDIA.

This is a view of roll-call in the British prison camp at Ahmedaagar, India, where more than 1,000 former Boer soldiers were confined.

In 1672 the Dutch East India Company purchased from the Hottentot chiefs, who claimed to be lords of the soil, the whole vast tract of country stretching from Saldanha Bay to the Cape peninsula.

Between 1685 and 1688 came a most important accession of strength to the Dutch settlers. Thanks to the revocation of the Edict of Nantes by Louis XIV., large numbers of Huguenots were driven from France. By arrangement with the authorities in Holland, it came to pass that some of these French Protestants, to the number of between two and three hundred, were taken to the Cape. They were granted free passages and as much land as they could bring under cultivation, and were assisted with money to buy implements, seed and other necessities, on condition of thereafter repaying the same. These French Huguenots, nearly all steady, honest and God-fearing folk, became a source of great strength to the rising colony.

During the last century the Boers spread

far and wide into Cape Colony, traversing pathless deserts, waterless karroos, and difficult mountain country, in search of new homes and pastures. Many of them were hunters pure and simple, and followed the elephants for their ivory. As they moved inland, magistracies were tardily established in their midst, not lest they might lapse into utter barbarians, but to enable an anxious government to draw its taxation from the land on which they settled. Churches and schools followed the settlers yet more tardily.

Far-removed though they have been from churches and pastors, they have yet clung closely to the primitive faith of their forefathers. Wherever they have trekked, the great Dutch Bible, often more than two hundred years old, and its lessons, have gone with them. At morning and at night, wherever they may be, prayer and thanksgiving are invariably offered up. It is the fashion among the "Uitlanders" to ridicule the long and somewhat dreary prayers of



ABYSSINIAN WOMEN IN HOLIDAY DRESS.

these Dutch farmers; yet, surely it is to the credit of the Boers that, amid every danger and difficulty, they have thus preserved their faith. Even when marching to fight the Zulu hosts under Dingaan in Natal, they offered up prayers at every halt, and the 400 farmers who met and conquered 10,000 Zulus at the Blood River in 1838 attributed their astonishing victory to the direct intervention of the Lord of Hosts in answer to their supplications.

In 1796 the British, by arrangement, with the Stadtholder of the Dutch Republic, then a fugitive from the armies of the French Republic, took possession of the Cape, which in 1803 was handed back to the Dutch. In 1806 the British, being then at war with the Dutch, again took possession of the Cape Colony, after a severe struggle near Cape Town. From that time

the Cape has been continuously in the hands of Great Britain.

The early Cape governors were not remarkable for their sympathy or friendliness for the Dutch settlers, and the grievances of the latter were seldom listened to. The fathers of the present Dutch population in the Transvaal and Orange Free State quitted their home in the Cape Colony, and trekked into dangerous and unknown deserts to avoid what they conceived to be gross and burning wrongs.



THE DIAMOND MINES OF KIMBERLEY

The five diamond mines are all contained in a circle three and one-half miles in diameter. They are irregularly shaped, round or oval pipes, extending vertically downward to an unknown depth, retaining about the same diameter throughout. They are said to be volcanic necks, filled from below with a heterogeneous mixture of fragments of the surrounding rocks, and of older rocks, such as granite, mingled and cemented with a bluish colored hard clayey mass, in which famous blue clay the imbedded diamonds are hidden.

In the first days of diamond mining there was no idea that diamondiferous earth extended to any particular depth, and miners were allowed to dig holes at haphazard, and prospect where they liked. When the Kimberley mine was discovered, a new arrangement was made, and in July, 1871, it was cut up into about 500 claims, each 31 feet square, with spaces reserved for about fifteen roadways across the mine. No person at first could hold more than two claims, a rule afterwards modified.

The system of underground working in recent years is as follows: Shafts are sunk in the solid rock at a sufficient distance from the pipe to be quite safe against reef movements in the open mine. The main shaft at De Beers starts about 540 feet from the north side of the mine, and is now over 1,500 feet deep. Tunnels are driven from this shaft at different levels to cross the mine from west to east, about 120 feet apart. These tunnels are connected with each other by two tunnels running north

and south, one near the west side of the mine and one midway between it and the east margin of the mine. From the east and west tunnels offsets are driven to the surrounding rock. When near the rock, they are widened into galleries, these in turn being stoped on the sides until they meet, and upwards until they break through the blue ground. The fallen reef with which the upper part of the mine is filled, sinks and partially fills the open space. The workmen then stand on the fallen reef, and

drill the blue ground overhead; as the roof is blasted back the debris follows. When stoping between two tunnels, the blue is stoped up to the debris about midway between the two tunnels. The upper levels are worked back in advance of the lower levels, and the works assume the shape of irregular terraces. The main levels are from 90 to 120 feet apart, with intermediate levels every 30 feet. Hoisting is done from only one level at a time through the same shaft. By this ingenious method of mining, every portion of blue ground is excavated and raised to the surface, the rubbish on the top gradually sinking down and taking its place. The scene below ground in



A GROUP OF ABYSSINIANS, IN THEIR OWN COUNTRY.
The inhabitants of this remote African kingdom are Coptic Christians, and consider themselves the chosen people of God.

the labyrinth of galleries is bewildering in its complexity, and is about as little like one's idea of a diamond mine as can well be conceived. Electric light is universal in the workings. One set of workers attends to the rock-drilling machines for blasting the blue ground; in other parts the blue is shoveled into wagons, which, when filled, are carried along rails by moving ropes till they get to the gallery, where the contents are sent to the surface.

At the bottom of the main shaft, at the 1,300-foot level, the galleries converge to a large open space where the tram lines carrying the trucks meet. In front is a chute to which the trucks full of blue ground are rapidly wheeled, tipped over and their contents discharged, when they are shunted to make way for other trucks. At the foot of the shoot is a "skip" holding 64 cubic feet, or four truck loads, an electric bell sounds at the engine-house, when the skip is hoisted to the surface and another takes its place. So the work proceeds, and on busy days ground has been hoisted at the rate of 20 loads every three minutes, equal to 400 loads an hour. In 1894 the record hoisting of blue ground at the Kimberley mine was 470 loads an hour; in one shift of eight hours 3,312 loads, and in a day of three shifts, 7,415 loads.

All below ground is dirty, muddy, grimy; half naked men, black as ebony, muscular as athletes, with perspiration oozing from every pore, are seen in every direction, hammering, picking, shoveling, wheeling the trucks to and fro, keeping up a weird chant, which rises in force and melody when a titanic task requires excessive muscular strain. The whole scene is far more suggestive of a coal mine than a diamond mine, and all this mighty or-

ganization, this strenuous expenditure of energy, this clever, costly machinery, this ceaseless toil of skilled and black labor, going on day and night, is just to win a few stones wherewith to deck my lady's finger.

The sorting room in the pulsator house is long, narrow and well lighted. Here the rich gravel is brought in wet, a sievelful at a time, and is dumped in a heap on tables covered with iron plates. The tables at one end take the coarsest lumps, next comes the gravel which passed the three-eighths-inch holes, then the next in order, and so on. The first sorting is done by thoroughly trustworthy white men; for here the danger of robbery is greatest. Sweeping the heap of gravel to the right, the sorter scrapes a little of it to the center of the table by means of a flat piece of sheet zinc. With this tool he rapidly passes in review the grains, seizes the diamonds, and puts them into a little tin box in front of him. The stuff is then swept off to the left, and another lot taken, and so on till the sievelful of gravel is exhausted, when another is brought in. The stuff the sorter has passed to his left as temporarily inspected, is taken next to another part of the room, where it is again scrutinized by native convicts again and again, and as long as diamonds can be found in quantity sufficient to repay the cost of convict labor, it is passed under examination.

The diamond has a peculiar luster, and on the sorter's table it is impossible to mistake it for any other stone that may be present. It looks somewhat like clear pieces of gum arabic, with a sort of luster which makes a conspicuous shine among the other stones.

In the pulsator and sorting house most of the native laborers are long-sentence con-

viets, supplied with food, clothing and medical attendance by the company. These men are necessarily well guarded, and all the white men in the works carry revolvers. Apart from the hopelessness of a successful rising, there is little inducement to revolt; the lot of these diamond workers is preferable to life in the government prisons, and they seem contented.

Sometimes as many as 8,000 carats of diamonds come from the pulsator in one day, representing about \$50,000 in value. Prodigious diamonds are not so uncommon as is generally supposed. Diamonds weighing over an ounce (151.5 carats) are not unfrequent at Kimberley, and, were it necessary, there would be no difficulty in getting together a hundred of them.



ABYSSINIA AND ITS ANCIENT CHRISTIAN FAITH

Just as very few are familiar with the fact that Egypt was once a Christian kingdom, for 259 years ending A. D. 640, so there are fewer still outside the circle of missionary enterprise, who know or care aught for the existing Christian Empire of Abyssinia, beyond its more recent political records. Yet Abyssinia has been Christian for centuries; and its late King John, who greatly enlarged its boundaries and extended its influence in Central Africa, bore, like some European monarchs, the title of "Defender of the Faith," most dear to the kings of Abyssinia.

The Christian period of Egypt, comparatively short in duration and unimportant in influencing neighboring tribes or communities, ended in the Arab conquest under Amru, which left but few vestiges of Christians or Christianity. To-day, a small Cop-



WIFE OF BEDOUIN CHIEF.

tic community in Cairo, respected more for the intelligence of its members, the chief accountants and clerks of the administration, than for their numbers or influence, and a few more scattered over various villages, alone attest the antiquity of Christianity in Egypt. But Abyssinia, the ancient Ethiopia, claiming to possess the primitive Christianity and boasting of preserving the relics of St. Mark the Evangelist, has ever held fast to Christianity, even though disfiguring it with strange superstitions, distorting it with fierce fanaticism, and showing even sterner savagery than animated the old Crusaders, with whom hatred to the heathen was equivalent to love of God.

Three great mountain chains forming a triangle, with its base resting on the Abai and the Kawash, and its apex at Massowah on the Red Sea, are the boundaries of an immense elevated plateau, upheaved by volcanic action from the sultry plains of

tropical Africa, but blessed with a climate as fresh and healthy as any in Europe. Indeed, the table-lands of Abyssinia, bounded on the north and west by the arid deserts of the Sudan, on the south by the country of the ferocious Gallas, and on the east by Debeni, Adal, and the great salt plains of Arrhoo, may be likened to some rocky island rising in the midst of the ocean, rich with verdant plains, bubbling streams and shady woods, but seldom visited by the mariner, owing to its isolated position and the terrible cliffs by which it is surrounded. Very seldom do the natives of the Abyssinian plateau venture down into the fever-stricken plains, where dwell their hereditary enemies, the Mahometans and the pagan Gallas. Nor, except when led to a

profitable and pious invasion of "Habash," do the people of the low countries often penetrate the wild passes of the Abyssinian mountains. It happens, therefore, that from whichever side the traveler approaches Abyssinia, he can glean but little information from the natives, concerning the country beyond the mighty wall of mountains which rise before him, as if to bar his path.

The Abyssinians trace the origin of their empire to the days of Solomon and the Queen of Sheba's visit to him; and their line of kings to the joint issue of those two potentates. Their religion exhibits a strange mixture of Judaism and Christianity; a great pride of race and religion animates this singular people whose monarch bears the haughty title of "King of Kings";



AN ARAB SCHOOL.

and they consider themselves not only the peers, but even the superiors, of all the rest of mankind.

It was the English expedition against King Theodorus, in 1867, that opened out the country and let in some light on its dark places. Great was the surprise of

THE RAILWAY RACE FOR THE INDIAN OCEAN

The greater European Powers have entered upon a remarkable race for trade and influence in the Orient. The remarkable products and the enormous commerce of



IN AN ARABIAN OASIS—THE EVENING CAMP.

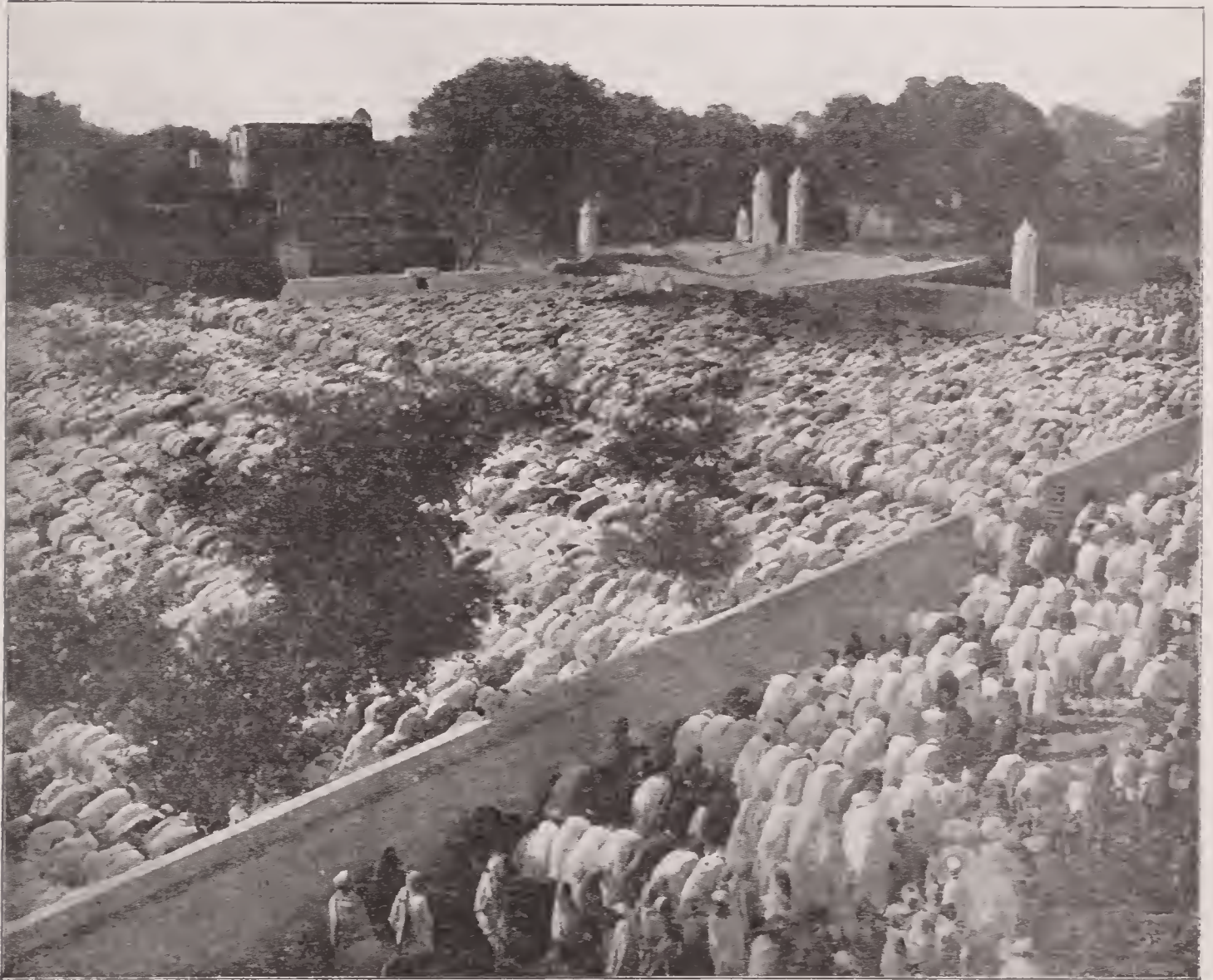
Christendom, which had previously classed the Abyssinians among other savage and warring tribes, leading a nomadic existence in the deserts and jungles of Africa, where the climate and wild beasts dispute with equally savage men the entrance or egress of the foreigner and repel the onward march of civilization. Since then they have defeated Italy in a disastrous campaign, undertaken to claim them as a colony.

Southern and Eastern Asia are tempting the commercial nations to use all their energy in securing a share of the profit that offers there. Steamships have supplanted sailing vessels in large measure, and now the tendency is toward railway construction. No European Power except Russia connects directly with the Orient by railways included entirely within its own territory, and inasmuch as the Russians have seized

their opportunity by building from Europe to the Pacific Ocean with a branch through Manchuria, the rival Powers are even more anxious to support their own interests in similar fashion as far as possible.

Persia and Turkey each offer natural routes by which communication can be established from Europe to the Indian Ocean by combined railway and steamship lines. Persia, once in ancient times the most powerful of nations, with Cyrus, Darius and Xerxes as its greatest rulers, is at last falling under the influence of the advance of western civilization and yielding to the pressure of European inducements. Ger-

many, England and Russia are all centering their attention on it with jealous eyes, each endeavoring to preserve Persian trade and Persian concessions to the exclusion of the others. Turkey likewise is the subject of constant pressure from more than one of the great western Powers, in the effort to obtain the same privileges. Comparatively short railway lines across Turkey from the Mediterranean or the Black Sea, or across Persia from the Caspian Sea, will connect European waters with the Persian Gulf on the south. From this Persian Gulf terminus the voyage is a greatly reduced one to the cities of the Orient and the East. The



MOHAMMEDAN PILGRIMS DRAWING NEAR TO MECCA.

Russians have prosperous steamship lines plying to every port on the Caspian, and except for the south shore, which is Persian, that great body of water, five times as large as Lake Superior, is a Russian lake. Indeed, the northern provinces of Persia itself, bordered by Russian railways in Transcaspia and by Russian steamship routes on the Caspian Sea, are now all but Russian. From Baku, the great petroleum port on the west shore of the Caspian, the railway system is extending southward toward Persia and the Russians apparently will have first access by this route to the Persian Gulf. French, German, Russian, Austrian, Italian and British steamships ply on the Black Sea and the Mediterranean, and of these countries Germany has the lead in railway concessions across Asia Minor to the Persian Gulf. The world is becoming smaller by the multiplication of new railway and steamship routes, and the traveler is profited by the rivalries of the Powers. The coasts of Turkey around the Black Sea and the Mediterranean have been accessible by numerous steamship lines, so that Turkish products and Turkish life have been fairly well known to the outer world. But Persia has been generally out of reach of observation and development.

With the new regime of western trade and western methods introduced, Persia is altering its manners very rapidly. The country is one of large resources, although the beautiful silk and wool fabrics are virtually the only products that are conspicuous in American and European markets. Persian rugs are prized as the choicest floor coverings for the houses of our own people, and Persian silks and shawls likewise are highly valued. They are of the finest quality and highly decorative in design.

DANCING AND HOWLING DERVISHES

There are two kinds of dervishes, the dancing and howling dervishes. The Tekke, where the religious dances of the former are held, in Turkey, is in Kassim Pasha, a village suburb of Constantinople. Also in the Sudan there are numerous sects of dervishes, all with their peculiar customs. There is nothing in the exterior of their buildings to distinguish them from other rather grim and prison-like houses in the long, narrow street of Constantinople. One's attention is drawn to the place by the train of solemn, brown-cloaked figures, wild-eyed and hollow-checked, who come toiling up the brow of the dusty hill, and disappear into the building. Weird looking beings they are, with the glint of the maniac in their eyes, but impressive and dignified in spite of their ludicrous dress.

The inside of the Tekke is a large, circular hall, with a highly polished marble floor and a promenade, for men only, round the dancing portion of it on the ground floor. A row of white marble pillars and a low marble screen separate the spectators from the dancers. Christian ladies present are taken up into the balcony. The division of the balcony, which is not screened off, is reserved for strangers of both sexes. Being Christians, it is not deemed necessary for the ladies to sit alone or behind the arabesqued grille.

A visitor describes one of these scenes as follows:

"It was weary work waiting for the dancing to begin. The orchestra had been playing with all its might, in a small division of the balcony entirely hidden from sight, music that until then I thought only a Chi-

nese band at a joss-house meeting could produce. It was the sort of noise that makes one's teeth ache, shrill whistles and queer stringed instruments of every shape and variety, positively shrieking out inspiration to the dancers. The noise was barbaric, and cannot be imagined by an ear unaccustomed to Eastern music. While this awful music was drumming itself into my brain and nerves, the dervishes were walking in solemn procession around the room. Their curious dress is made of thick, soft, sand-colored felt, and their high hats reminded me of a pailful of sand turned out on the seashore. When the figure is not in motion, the skirt hangs in soft, close folds, reaching to the ankle, and when the dancer is spinning round and round like a teetotum it flies out into a complete circle, getting larger as the motion increases in rapidity. A dancer with accordion pleats could hardly do more. A dervish of high position sits in a sort of throne, raised on a low dais at the east end of the building. When the dancers, who walked round the building with their arms folded across their breasts, reached his throne, they bowed low, facing Meccaward, and passed out of his presence backward. This solemn walking and endless bowing seemed to last an hour and a half, the rasping orchestra doing its best to work up their feelings to the necessary pitch of excitement.

"Quite suddenly it had the desired effect, for a small figure, one of the youngest of the company, glided silently off the red matting which led up to the dais and commenced the famous dance. Eastern nations seldom move their feet from the floor, and the dervish dancers in this respect are much the same as the Japanese geishas and the Indian nautch dancers; in fact, to the Eng-

lish mind it is not dancing. I had hoped that they would whoop and shout and jump about in a wild corroboree, like the Australian aborigine or the Indian of America, but their dancing is as solemn as their walking. With their arms extended out as straight as possible, they spun round and round the room on their bare feet. The giddiness of the motion became sickening to look at. One after another they glided over the polished floor with their feet close together and their arms extended, until they made the room look full of human pegtops. But the dancing soon became as monotonous as the walking had been, and all that we were waiting for now was to see them drop down in a fainting fit from exhaustion. I watched their faces change from the awful sallowness which is their natural color to a dull red, and from a dull red to a horrible crimson, and then back again to a more ashen hue than before. The different stages of fatigue were horrible to witness. Round and round they went, until the whole room seemed to be revolving on its axle. In my fancy the white marble pillars had left their accustomed place and had joined the wild-eyed figures down below. I felt that it was time to go, and I staggered across the balcony and groped my way down the narrow stair. As we were going out we saw two of the dancers being carried out of the building."

The howling dervishes wait for the inspiration "to howl," while the band plays the same class of music as has been already described, or, if possible, worse. While they are waiting they stand with their backs rigid against the wall of the building and their arms folded across their chests. Softly the "howling" begins. It is only a low moan at first, and very gently the bodies



SCENE ON THE GEORGIAN MILITARY ROAD THROUGH THE CAUCASUS MOUNTAINS.

bend forward from the waist, but the moaning gets louder and louder, the bodies bend further and further forward until their foreheads almost touch the marble floor. Within half an hour's time the howls get fiendish and the gray-robed figures rock themselves back and forward with horrible violence and rapidity. Their balance is marvelous, for they never move their feet or knees. One after another becomes purple in the face, and their wild eyes seem starting out of their heads. Mad yells make your blood run cold, and you do not wait to see the end of the entertainment.



PILGRIMS TO MECCA

Every year thousands upon thousands of pious believers in the name of Mohammed desert their homesteads and wend their way, both by land and by sea, towards the country that saw the birth of their religion and witnessed the miraculous deeds of their archprophet. From China, India and Persia; from every quarter of the Turkish Empire; from Egypt, Tripoli, Tunis, Algiers, and Morocco; from Zanzibar and Senegal; from Kurdistan and Afghanistan; from the Sudan and the great Sahara, and from many other places whose existence we are but dimly conscious of, they throng, many poor, ignorant and dirty, but devout and determined in their purpose. They are pilgrims to the holy cities of Arabia, Mecca and Medina, and to reach them they starve themselves for years to save up sufficient money to defray their expenses, and endure horrible privations by the way. They commit themselves to the mercies of the vast and awe-inspiring sea, dreaded by all true Orientals; they risk being robbed by the

Bedouins or killed by the heat, and all with an amount of phlegm and good humor that is almost sublime. Whatever happens to them they care not; God will provide for them, and should they die on their way out they will be received all the more readily into the mansions and the arms of the voluptuous houris already provided for each one of them by their much-beloved prophet in the seven-storied paradise of Islam.

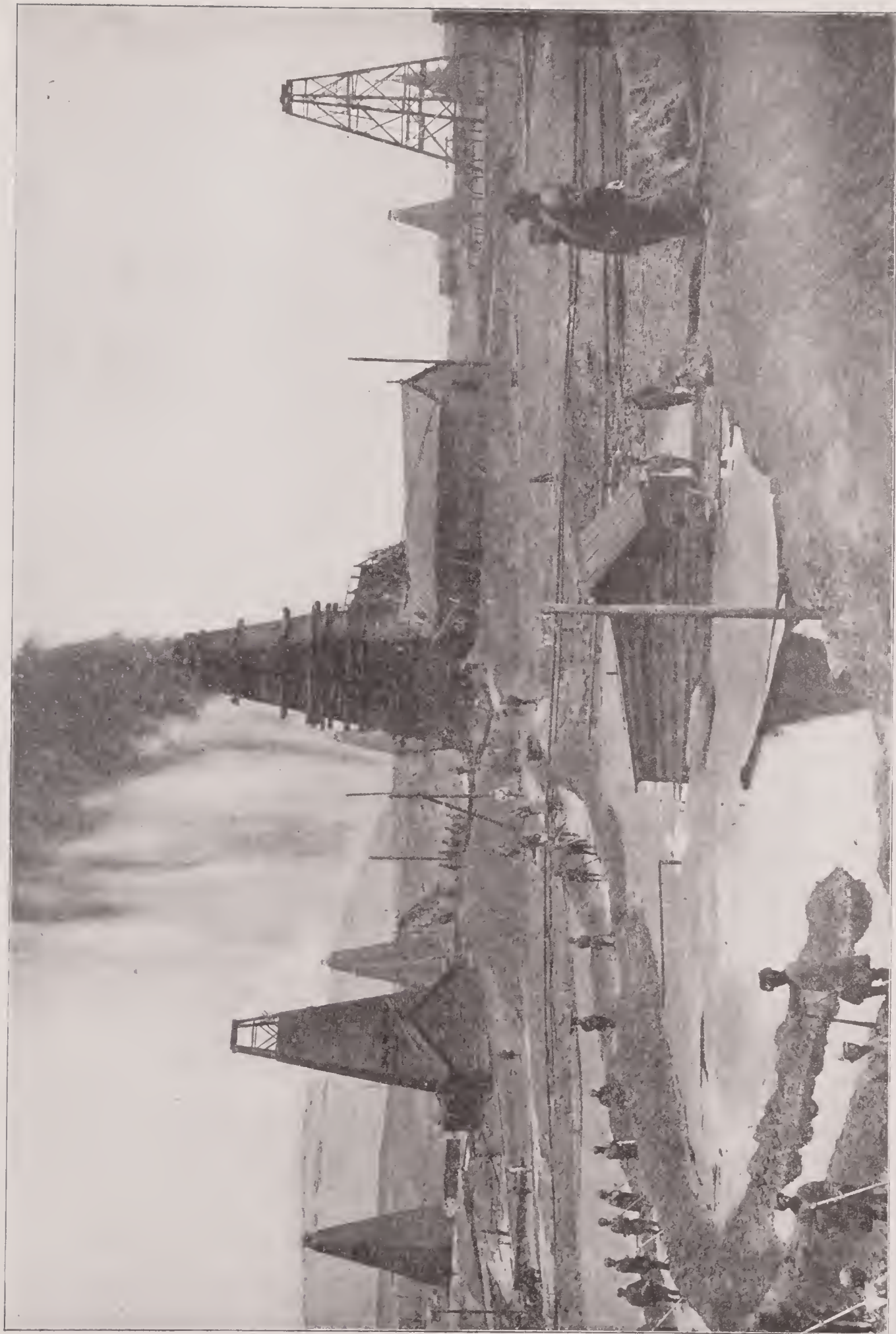
It is incumbent on all good Moslems to perform this pilgrimage at least once, if they can afford it. Many perform it several times, and some make a business of it, and hire themselves out as substitutes for others; for a pilgrimage by proxy is considered to be as effective as one performed in person, provided that the person in whose behalf it is performed be dead. No one can hire a substitute during his lifetime, but he may leave a provision to that effect in his will. This pilgrimage must not be considered in the light of a penance, after which the hadji is to receive a plenary indulgence for past sins. It is an ordinance of the religion of Islam, of the same nature as the Eucharist, whereby the believer is supposed to be brought into closer communion for the time being with the Deity and his human representative.

Of course it is easy enough to declare that one is not able to afford the expense of the undertaking, and many, without the least odium being attached to them, excuse themselves on that plea, for it is expressly ordered that no man unable to pay his own way without being an incumbrance to any one else should attempt it. The necessary expenses vary according to the station of the hadji. A poor man starting from the shores of Persia could perform the whole pilgrimage and get back for about three



DEPARTURE OF THE SACRED CARPET FROM CAIRO, FOR MECCA.

Once a year the Khedive sends a beautiful carpet to the tomb of Mohammed, in charge of the Mecca pilgrims. It is hung in the tomb until brought back by the next year's pilgrims, when it is given to some mosque which it is desired to honor.



A GUSHING OIL-WELL IN THE BAKU FIELDS, RUSSIAN CAUCASUS.

hundred and fifty rupees, or about \$110. A person of any consequence would probably spend a thousand rupees; and of course a rich man could, if he liked, spend a much larger sum. Yet not much opportunity for display is allowed.

All around Mecca there are certain places, forming a circle round the city, after passing which the pilgrimage begins in earnest. For men no covering is allowed but a couple of white towels or bits of calico sheeting, one fastened round the waist and the other thrown over the shoulder. On women, also, no jewel or ornament of any description is tolerated, robes of snow-white linen constituting their only apparel.

In the present age of increasing facilities in travel, the pilgrimage is made in all the cheapness and comfort desired. The scenes of vast multitudes, reduced to a common level, coming to the tomb of the prophet, are indescribable in their picturesque and motley array. Modern sanitary precaution and discipline have reduced the danger of disease and the terrors of the pilgrimage have been removed. Where formerly the host of pilgrims slept upon a blanket, most of them now come in groups and have tents, thus, during the season, presenting the picture of a vast army encamped on the plains.



MOUNTAINS AND OIL-WELLS OF THE CAUCASUS

Two great petroleum monopolies virtually divide the world's markets between them, one, the Standard Oil Company of the United States, and the other the corporations controlled by the Rothschilds in Europe. Of course there are minor companies with local trade in many countries, but the greatest volume of traffic in petro-

leum or naphtha and its products is in these hands. In America the oldest and most famous oil fields are those of Pennsylvania and Ohio, although other isolated regions have shared the production. Of late California has contributed to the American supply, and latest of all the remarkable discoveries centering at Beaumont, Texas, have startled the world. Here gushers producing from 30,000 to 70,000 barrels of petroleum a day have been opened, and apparently the field waits for nothing but ample transportation facilities to become the most important of all factors in oil trade.

The greatest developed oil field in the world, in some respects surpassing even the American oil-bearing districts, is that which centers at Baku, a Russian port on the west shore of the Caspian Sea, just south of the Caucasus Mountains. The Caucasus is a great range which extends from the Black Sea to the Caspian Sea, forming the boundary between Europe and Asia. The country to the south of the range was formerly included in the ancient Asiatic kingdom of Georgia, but for the last century it has been a part of the Russian Empire, and is called the province of the Caucasus. The capital is Tiflis, about half way between the Black Sea and the Caspian. A railway connects Batum on the Black Sea, with Baku on the Caspian, passing through Tiflis.

The latter city may be reached, however, by a more picturesque route from Europe. The Russian railway systems in Europe extend to the city of Vladikavkaz, in the foothills of the great mountain range, exactly opposite Tiflis. Between the two cities a remarkable road was built by the Russians nearly a century ago, called by them the Georgian Military Road. It is 126 miles

from Vladikavkaz to Tiflis and a large portion of the way is traversed by this stupendous mountain range. The road passes through the Dariel Gorge, which for centuries has been the pathway of armies moving back and forth between Europe and Asia. This was the path by which the barbarians of the north made their incursions upon the highly civilized eastern provinces of Greece and Rome, and back through the same gorge the legions drove them. Now the peaceful traveler over this remarkable road crosses the summit of the range at a height of nearly 9,000 feet, among the eternal snows, and sees the peak of Kazbek frowning over him, that mysterious mountain upon which mythology located the scene of the tortures of Prometheus who was punished for his theft of fire from Mount Olympus. Once over the summit of the pass, the traveler descends into Asia by way of the most remarkable zigzag known to mountain roads. The accompanying illustration shows the descent down the mountain side from the barren granite above to the smiling valley below. In the course of the road as it may be traced in the picture, the distance traversed measures approximately ten miles and the descent is more than 2,000 feet.

The contrast between the titanic mountain scenery of the Caucasus and the industrial activities of Baku is a striking one. At Baku the earth and the air are saturated with petroleum. Hundreds of great oil wells are pouring their liquid wealth into immense reservoirs, to await shipment by rail or vessel to the European and Asiatic markets where the product is consumed. Sometimes a great well bursts from all restraint, and pours forth a flood of petroleum which runs to waste until the stream

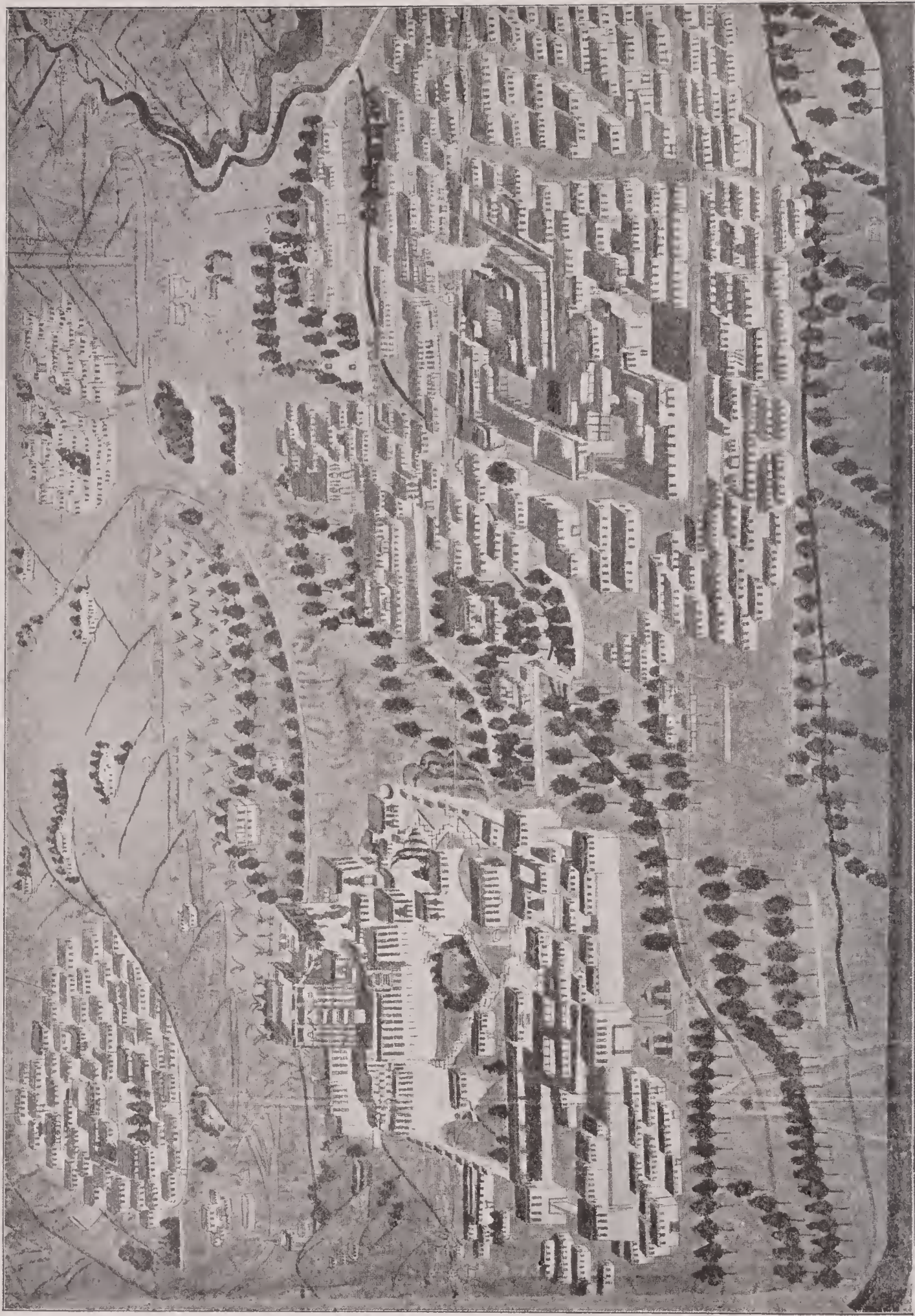
can be diverted into some earthen reservoir. When fires occur here there is little to do but let them exhaust themselves. Sometimes the losses reach millions of dollars before a limit can be placed upon the ravages of the flames. The Baku oil fields seem to be inexhaustible and already they have brought immense wealth to all those heavily interested in them. The annual product of petroleum here is nearly 50,000,000 barrels.



AFGHANISTAN, THE "BUFFER NATION"

The land of the Ameer lies north of India like a great wedge, having the sharp end at China and the head against Persia. The Ameer has been noteworthy because of his country's peculiar geographical position. This has made him the most prominent man in the councils of the Mohammedans because he was in a position to mediate and decide between the Moslems of India and those of Turkey. It also gave him great prominence in the political games of Central Asia, because he held neutral territory between the advance of the Russians from the north and the English from the south.

The Ameer is absolute in his dominions, and his rule is both personal and arbitrary over his four or five million subjects. Some of his punishments are very peculiar. As examples, an old man expressed doubts as to the wisdom of certain acts of the Ameer and he was sentenced to have the beard on one side of his face publicly pulled out. A baker who had been convicted of selling short weight was sentenced to sell over weight at the same price for a month. A young man became frightened at the appearance of horsemen in the distance and so



LHASA, THE FORBIDDEN CITY OF THIBET.
This picture of the mysterious Buddhist capital is from a painting by a Thibetan artist.

reported that the Russians were coming. For this he was compelled to stand from daylight till dark on the top of a post, just within reach of a soldier's bayonet and yell at the top of his voice, "The Russians are coming to Kabul."

The Afghans are divided into clans or tribes. They are good horsemen and are almost wholly agricultural in their pursuits. The English have tried to bring them under their influence both by war and by bribery, but the use of force has been disastrous and the bribery but of temporary value.



BOKHARA AND CENTRAL ASIA

Down in the heart of Central Asia is the Russian vassal state of Bokhara, recently opened to the world, or at least to those who obtain permission from the Russian government to visit it, by the construction of the Transcaspian Railway. Until the conquest of the Khanates of Turkestan by the Russian Empire within the last thirty years, the capital of this remote native state ranked with Mecca and Lhasa as one of the forbidden cities of the world. Hardly more than fifty years ago, two English officers, making their way to the city of Bokhara from India to negotiate a treaty of peace between Great Britain and the Emir, were put to death by the most horrible tortures, prolonged through a considerable period.

Since then the Russians have built a great railway, parallel with the one more celebrated a thousand miles farther north, which penetrates the deserts and plains of Central Asia almost to the frontiers of India and Mongolia. The Transcaspian line has been kept in the background by the Rus-

sians, while the Transsiberian line has been made conspicuous in every way. The reason for this is that the former was built entirely for military and political purposes to threaten the Afghan and the Indian frontiers, and to facilitate the conquest and maintain the peace of the Czar's new possessions in Central Asia. So it is that the famous old cities of the realm of Genghis Khan and his great successor, Tamerlane, are now reached by the direct line of railway from the Caspian Sea.

Tashkend, Khokand, Samarkand, Bokhara and Merv are stations on the line where Orient and Occident meet in peculiar conglomeration. The ancient architectural remains left by Tamerlane are still beautiful and sufficiently preserved to reward the long and tiresome journey required to reach them. The tomb of Tamerlane stands in Samarkand almost as it stood five centuries ago, a noble dome rivaling in its own way the tomb of Napoleon in Paris, or the Taj Mahal of India. But the Russians are to-day dominant in all the great land included in Tamerlane's realm. It is merely a Russian figure of speech to call Bokhara, Khiva and the other vassal states which they tolerate even semi-independent. The Emirs are left a shadow of authority over their own people, but the paw of the Russian bear reaching down from the north is over them all.



TIBET, THE HERMIT NATION

Buried deep in the heart of Asia, and separated from the burning plains of India and from the populous regions of China by stupendous ranges of snowy mountains, there lies a wonderful land. This land is Tibet. Its physical features are most re-

markable, for the country seems to consist of a vast central plateau, the greater portion of which lies at a higher elevation than the top of Mont Blanc, and from which descend on all sides great valleys, traversed by the Hoang-ho, the Yang-tsze-kiang, the Brahmaputra, and the Indus. The Tibetans themselves are a morose and gloomy race, and sunk in poverty and filth, seem to be degraded members of the human family.

But perhaps it is the religion of the Tibetans which is the strangest feature of the country, for the Tibetans are Buddhists of a most extraordinary character. All over the mountains in the inhabited portions of Tibet, are scattered the convents of the Lamas, which are full of monks and nuns, ruled by abbesses, and by Lamas in red and yellow robes, with mitres on their heads, and with tridents and praying-wheels in their hands. Multitudes of pilgrims traverse the roads which lead to the holy city of Lhassa, the capital of the country; and in the great temple at Lhassa, which is splendidly adorned, the Buddhist priests and monks chant the service, in the presence of crowds of devout worshippers.

Another wonderful thing connected with Tibet is the jealous way in which it is guarded by its inhabitants, and the extraordinary care taken by them to prevent Europeans from entering the country. On the side of India every mountain pass is carefully watched, and any European who attempts to enter Tibet from this direction is instantly turned back. On the side of China the frontier is guarded with equal care, and so perfect is the cordon in this quarter, that although the borders of Tibet may be reached, they cannot be passed.

The Indian Government has trained Hindu Pundits to travel in Tibet and make

scientific observations; but even this has to be done with great secrecy, and their scientific instruments have to be carefully concealed. On the frontier, these Hindus are strictly examined by the Tibetans, and are frequently turned back. Often, however, they are successful; and after traversing unknown portions of Tibet, they return to India and report their discoveries to the officials of the British Government, by whom they are rewarded.

The most remarkable journey undertaken by these trained Hindus was performed by the Pundit Nain Singh in 1874. He entered Great Tibet from the west, and leaving the head waters of the Indus, ascended to a vast table-land, divided by a range of mountains from the Brahmaputra on the south, and stretching away for an unknown distance towards the north. Having reached Lake Namcho, he crossed the snowy mountains which rise along its southern border. Then he entered the habitable portion of Tibet, with its towns, convents and monasteries, and ultimately made his way into Assam, and thence to Calcutta.

Others have lost their lives in attempting to penetrate to Lhassa, the capital. A. Savage Landor was desperately tortured and mutilated before he was ejected from the territory. Only foreign occupation with troops can open this strange land to visitors and to modern civilization.



THE YOGI OF INDIA

The possession of mysterious and occult power not possible to ordinary mortals has been for ages attributed to a sect of hermits in the mountains north of Delhi in India.

They live in monasteries like those of the Middle Ages and have the cadaverous look

to be achieved only by extraordinary self-training in feats of bodily suffering and endurance, as practiced by the severest ascetics. They claim to be able to do naturally by their occult powers, what to ordinary mortals is miraculous and supernatural. They throw a rope into the air, in the semi-darkness of evening, where it remains suspended till one of them climbs up on it out of sight and returns. They bury one another alive and at the end of weeks or of months disinter and revive the one who was buried. But regardless of the vast mass of evidence regarding these miracles, they are but little believed in and have been often explained as optical illusions and clever tricks. They claim to attain to the power even of the suspension of animation through severe fasting and mental abstraction. Throwing themselves into a state of hypnosis, they are able to suffer many remarkable things to be done with themselves.

They are the religious conjurers of India and have long been able to impress their mysteries upon many learned men of undoubted sincerity and honor. However, their feats have lost their serious interest to all but the Theosophists, and no longer deserve more attention than given to combinations of conjuring with hypnotism.

THE ISLAND TEMPLES OF INDIA

Elephanta, which the natives call Gallipouri, is a small island on the Indian coast, nearly opposite Bombay. The huge stone elephant on the south shore, which has been apparently split in two by gunpowder, gave its name to the island, and is so good an imitation of the real article that, at a short



A SNAKE-CHARMER.

distance, even an eye accustomed to elephants might be deceived. This seems to have been a work of supererogation, a sort of playful freak on the part of the architect, mortal or otherwise, that served as a preparation for the wonders to be seen within the cavern pagoda. The horse, too, is repre-

sented as "so lively, and with such a color and carriage, that many have fancied it a living animal."

This temple, or Pantheon of the gods, who in India are deified heroes and princes, is about half-way up the steep mountain, from the stony heart of which it has been excavated. It forms a complete square of 120 feet, and is 18 feet in height. The four rows of pillars, on which the solid mass of rock above is supported, are exquisitely proportioned, but of no received school of architecture. Each finely-fluted column rests upon a square pedestal, and is larger in the center than at any other point. The rich

capitals have a flat appearance, which has been compared to that of a cushion pressed together by the weight of the mountain overhead. A stone ridge, like a beam, crosses the tops of these capitals; it is about a foot thick, and profusely ornamented with carved work.

Forty or fifty colossal statues stand out from the sides of the cavern in such wonderful bas-relief that, although they are not detached from the rock, the rounding of each figure is so perfect that a careful examination is necessary to convince the spectator of this fact. These figures vary in style and character; some wearing the pyramidal



ENTRANCE TO THE CAVES OF ELEPHANTA.

helmet of the warrior, others with crowns ingeniously wrought, and splendid with jewels, while some of the heads are without ornament, save that of curled or flowing tresses. Hands are plentiful with these heroes and princes, who do not appear to have found four, or even six, too many for them; and these numerous hands are generally filled with sceptres and shields.

Some of these worthies have undeniably bad countenances, and are described by an ancient writer to be of such "horrible and fearful forms," that they "make a man's hayre stand upright." Others look serene and benignant, while on the features of others are marks of dejection and anguish. The gorgeous Indian dress in which they are attired, with heavy ear-jewels, magnificent collars sparkling with gems, fancifully wrought belts, and rich bracelets on arms and wrists, makes a picture that fairly dazzles amid the gloom of the cavern.

The nearest of these figures to the entrance, and facing it, is an enormous bust. Its three heads, joined behind the ears, represent the grand triple deity of India—Brahma, Vishnu and Siva. The great breadth and depth of the central head are evidently the sculptor's expression of the supreme presiding deity. A face that is five feet long, with a nose of a foot and a half, conveys a practical idea of power that is further enhanced by a shoulder expansion of twenty feet. An immense jewel sparkles like a solitary star in the pyramidal cap that crowns the head, while a broad collar of pearls and other precious stones adorns the neck. The sleepy, placid expression of the face is supposed to express "that absorbed state which constitutes the supreme felicity of the Indian deity."

The head on the right of Brahma is the

preserver, Vishnu, smiling and gazing with rapt admiration on the sacred lotus which he holds in his left hand. The destroyer, Mahades, scowls on the other side, and looks the very incarnation of malice. His tongue is thrust out, and the large hooded snake grasped in his right hand seems only the natural expression of his own evil nature.

On either side of this triple-headed bust is a majestic, whole length figure, wearing the three-fold cord of Brahma, and supposed to represent a subdar, or priest of that deity. Farther on is the figure of an Amazon, which seems curiously out of place



HINDU BABY IN ITS CRADLE.

in a Hindoo temple. It is in the midst of thirty uncouth statues, and has four arms, the right fore-arm resting upon the head of a bull. The left fore-arm hangs down, but whatever it holds has been mutilated past recognition. The hand of the hinder right arm grasps a hooded snake: the left a round shield. This brings back the theory of Semiramis: but it is supposed again that, as Herodotus writes of Scythian Amazons, the statue may be accounted for by the connection which, in early ages, seems to have existed between India and Scythia.



A SIAMESE BELLE.

The sacred Zennar of Brahma which adorns so many of these sculptured figures, the striking representations of the very gods now worshipped in India, and the assertion of Niebuhr, who declares that he saw the islanders paying homage to the images in the temple of Elephanta, all seem to contradict the theory that the rites of a religion quite different from that now prevailing in

India were practiced in these cavern pagodas.

At one end of this wonderful temple is a dark recess twenty feet square, with no outside ornament except the eight naked figures, thirteen and a half feet high, that seem to be starting from the wall to which they are attached. These figures are ornamented in the same gorgeous fashion as the other statues, with rich collars about their necks and immense jewels in their ears. They guard the sacred mysteries of a debasing worship, whose serpent-like trail disfigures all Indian temples and paintings.

The crushed appearance of Elephanta's flat roof and comparatively low ceiling is a prominent defect in this famous temple; but it is, nevertheless, a palace of wonders, and in contemplating the life-like forms that stud the massive rock from whence they seem to have sprung, the spectator almost feels that the spirits who were supposed to work in the bowels of the earth could alone have accomplished such results.



SIAM AND ITS STRANGE PEOPLE

Siam is the Holland and Venice of the far East. During a part of the year the best of its lands lie under water and the people move from one village to another in boats. The rivers and canals are the highways of the kingdom, and the city of Bangkok, the royal capital, has more houses built upon piles than have the piled cities of Amsterdam and Rotterdam, and its canal streets surpass in number the waterways through which go the gondolas of Venice. Bangkok is even more built upon the waters than is the famed queen city of the Adri-

atic. Venice rises from the sea and its foundations reach down into its sand. Bangkok floats upon the bosom of the mighty Menam River, and its hundred thousand dwellings rise and fall with the tide. The Menam is called the mother of waters and Bangkok, its most beautiful daughter, is soothed during the day and lulled to sleep at night upon the bosom of this mighty mother.

Bangkok has few things in common with its sister city of Italy, and it differs from Venice as the half-nude savage maiden of the tropics, laden with barbaric gold, differs from the fashionable girl of our modern civilization, clad in her latest Parisian dress. Imagine a low, flat country filled with the most luxuriant of tropical vegetation. The wind sighs through the palm trees. Birds of the gayest plumage fill the

air with their tropical songs. In the jungle is heard the chatter of the monkey, and along the flat streams basks the alligator. A low, clear blue sky, in which the sun of the tropics shines its hottest, hangs over it, and at night the moon and the stars shine with an untold brightness. Sailing up this river, from the Gulf of Siam, at about thirty miles from its mouth, you note in the distance the spires of temples and palaces. As you go on, from out the palm trees on each side shine little one-story houses, their roofs thatched with palm leaves, and their foundations apparently rising from the water itself.

There are no cellars in Bangkok and each home has a hole in the floor through which the sweepings are thrown. At two or more corners of each of these dwellings a pole has been driven down into the mud, and the



A STREET IN COLOMBO.

house is anchored to these. Its owner pays a ground rent to the person owning the land on the banks in front of which the house rests. But in case of dispute the moorings are cut, and the house, family and all, float away to another location. There are fifteen miles of these floating houses. They line both banks of the river and the canals back into the jungle. It is not uncommon for the owner of a floating dwelling to anchor his

It is estimated that 50,000 out of the 700,000 people of Bangkok live thus upon the water. There are thousands of children here who have never had a play-ground bigger than the fifteen-foot veranda in front of their homes, and whole families live through generations in one of these three-roomed floating houses without having spent a night upon the land.

All of the women have short hair, and some of them would be beautiful were it not for the universal custom of betel-nut chewing. The betel-nut is the product of a palm tree. It is about as large around as a walnut, and its meat is of a soft, spongy nature, the taste of which suggests the astringent properties of the unripe persimmon. The natives cut these nuts into quarters, and when they chew them they add a mixture of pink colored lime and tobacco, which, with the betel-nut, makes the compound which they munch from morning till night. After a short time it becomes a cud, and they lodge this between the lips and the teeth when not engaged in chewing. The chewing produces a blood-red saliva, which turns the teeth from white to polished jet, makes the lips crack, contracts the gums so that the teeth become long black fangs, to disfigure what would be otherwise fairly beautiful faces. Betel-nut chewing is followed by all Siamese, from the lowest to the highest, and a nobleman going through the streets has always his servant following him, bearing a box of silver or gold half the size of a cigar box, in which are choice mixtures of betel and lime.

All of the Siamese men, women and children, smoke as well as chew. You see cigarettes and cigars, unlit and half-smoked, behind the ears of both sexes.

Siam is the land of the white elephant,



TEA-PICKER, CEYLON.

house in the middle of one of the narrowest of these water avenues, and boats passing by must get through as they can. The native houses of the land are built high up on piles, so that one could almost walk under their floors. Some of them have picturesquely pointed ridge roofs, but like the floating houses, they are as a rule small, and their interior arrangements are the same.

and the king has four white elephants in the imperial stables which adjoin his palace. Great burly beasts with mouse-colored skins speckled by disease, they have been shorn of their glory, and their tusks are no longer bound with gold nor are their bodies swathed in cloths of purple velvet. Heavy ropes have taken the place of golden chains in binding their ankles. These elephants are often used in the grand processions of the king. At such times they are decorated with something of their old grandeur. Pavilions are tied upon their backs and the royal family ride out in state.



CHINESE FOOD AND COOKERY

John Chinaman always has a bowl at his elbow at meal-time, which he fills with rice from a vessel on the table, a large spoon or ladle being used for this purpose. This bowl is held in the left hand, and brought near the chin from time to time, when the rice is shovelled into the mouth by a pair of chop-sticks, taken between the thumb and fore and middle fingers, instead of being used separately, one in each hand, as is sometimes supposed. In the boats on the rivers of China, children of all ages are seen, late in the day, with bowls, which they take to their mothers to be filled with rice, and it is curious to see the avidity with which they consume their invariable diet. Many poor people know no other dish than this; but those who can afford a little variety, are glad to spend a few "cash," as the smaller Chinese coins are called, in the purchase of fish, flesh or fowl, to give a relish to their monotonous vegetable. On the river boats may be seen the rude implements of these floating kitchens, consisting chiefly of

a large boiler, resting upon an earthenware pan. This serves as a furnace, and "all-outdoors" does duty as a chimney. Within the pot containing the rice, as it sizzles and steams away, are pans placed on a grating. They hold such savory accomplishments as the natives use for side-dishes.

The Chinese are very fond of gelatinous substances, and this accounts for their using animals and parts of animals for food which are rejected in other countries, and their penchant for such delicacies as tri-pang, birds'-nests, sharks'-fins, fish-maws, and agar-agar, a vegetable glue made from sea-weed. Among fish, the sturgeon is highly prized, and, as in classic times, is considered worthy of a princely banquet. The expression "caviare to the general," used by Shakespeare to illustrate anything above the taste or comprehension of the common people, attests the estimate formerly placed upon this fish by epicures, caviare being the roe of the sturgeon. A very choice delicacy for Chinese tables is sturgeon skull-cap, made from the most select portions of the royal fish. Shark-fins and pork are also highly esteemed. An English traveler, who partook of a dinner at which these were served, says the Chinaman must have smiled at the unreasonable prejudices of the Occidentals when he saw some of them tasting the pork, but fighting shy of the shark. He adds that the monster's fins were boiled to so soft a consistency that they might have been turbot-fins. The Chinese pork has a shining, flabby appearance which is not attractive to foreign eyes, and its rank, coarse taste does not invite renewed attention from the wary stranger. Cut into thin slices and fried in soy, which relieves the gross flavor of the meat, it is not absolutely repulsive.



SAILING SLEDGES ON THE GRAND CANAL OF CHINA.

In winter as in summer the Chinese waterways are the chief arteries of traffic. To assist his progress the ingenious Chinaman rigs up a sail in the manner pictured.

One of the most cherished delicacies of Chinese epicures is the beche-de-mer, or tripang, a kind of sea-slug, fished for on the coral-reefs of the Eastern seas. This marine animal is hardly less peculiar in his habits and appearance than the "heathen Chinee" who delights to devour him, being both tough and flexible, able to stand erect and graze on the sea-grasses, or to crawl and digest vast quantities of shells. With his tubular feet, or feelers, he seizes the unwary mollusk, which, firmly held by these suckers, is passed into the mouth of the slug, where it is speedily crushed and thrust into the stomach. From his resemblance to the familiar product of our gardens, this wandering echinoderm is called by sailors the sea-cucumber.

Another gelatinous delicacy of the Chinese is the birds'-nest. This is the habitation of a small swallow called, from its having an edible house, *Hirundo esculenta*. These nests are found on most of the rocky islets of the Indian Archipelago, though Java and Sumatra furnish the principal supply. They are composed of a mucilaginous substance resembling coarse fibrous isinglass in external appearance, and in color are reddish white. Hardly thicker than an ordinary teaspoon, the weight of one of these little articles is from a quarter to half an ounce. The quality of the nests depends on the character of the caves, and the time in which they are taken. The best are obtained before the young swallows are fledged; next in value are those containing eggs only. Those which have been occupied by the newly-fledged birds, are rendered nearly worthless by blood, feathers and dirt.

These nests are obtained twice a year, the most valuable being found in deep, damp caves, which, unless essentially changed in

character, will long continue to shelter the swallows and their nests. It was formerly supposed that the materials used by the birds in building these habitations, was the spawn of fish, or of beche-de-mer, but this view, however conformable to the principle of natural selection on the part of the birds in choosing such dainty delicacies to gratify the Celestial appetite, seems to be contradicted by the fact that some of the most productive caves are situated fifty miles from the sea.

The difficulty and danger experienced by the gatherers of these nests, furnish a new illustration of the tyranny of the human palate over the lives and happiness of men. To obtain the nests is the business of persons who have been trained to it from their youth, for no inexperienced person could safely undertake it. The caves are approached by ladders of bamboo and rattan let down over precipices, often descending perpendicularly for hundreds of feet over a sea beating violently against the rocks. After reaching the mouth of the cave, the seeker for nests gropes along on narrow ledges, where he is obliged to cling with his hands to slippery crevices, and penetrate gloomy recesses, where a single misstep would precipitate him into the yawning abyss below, to be dashed to pieces by the turbulent surf. It is often necessary to use torches to light the wanderer on his way, and reveal the places where the nests are hidden.

The Chinaman, believing that cookery is the test of civilization, regards the carving processes of European and American society as conclusive proof of barbarism. An Englishman's mode of feeding, he says, allies him to the savages of Formosa; the chief labors of the slaughter-house being

transferred to the dinner-table, and the principal work of the kitchen being performed by the stomach. "In remote ages, before we became civilized," said a polite Chinaman, "we used knives and forks as you do and had no chopsticks. We still carry a knife in our chopstick-case but it is a remnant of barbarism—we never use it. We sit down to table to eat, not to cut up carcasses." Undoubtedly, the Chinese sys-

tem is admirably adapted for dyspeptics, as well as for that large class of persons whom necessity or inclination prevents from taking exercise enough to digest a mass of solid food.

Cats and dogs are eaten to some extent by the Chinese, but generally when young and tender. As those intended for the table are usually fed upon rice, their flesh is more palatable and cleanly than that of their

brethren in other countries. They are sold alive in cages, and their dolorous cries, sometimes attributed to consciousness of their impending fate, are more likely the result of ill-treatment on the part of the hawkers, or of discontent with their peripatetic prisons. To ascertain the age and health of these creatures, buyers open their mouths and examine the teeth, so that puss and pup are subjected to a good deal of disagreeable scrutiny before being swallowed by the Celestials.

Frogs are favorite articles of food in China. They are caught by fastening a youthful specimen by the waist to a fishline, and bobbing him up and down in the grass and grain of a rice-field, the favorite resort of his old-



BUDDHIST ROCK TEMPLE IN CHINA.

er brethren. One of these old croakers jumps at the squirming youngster, swallows him whole, and is himself secured, while the young one is rescued from the maw only to be used for bait again until death relieves him.

It is not likely that Chinese delicacies of the table will ever become popular in this country. On the contrary, John Chinaman, appreciating the dietetic conditions of our civilization, will probably conform to our customs in this as in other respects. We shall long continue to use his tea, but it is more than doubtful whether the coming man will drink samshu, or eat sea-slugs, birds'-nests, cats or dogs.



CHINESE BEGGARS

The condition of the Chinese poor is very bad, judging from a European point of view, for in their wretched huts—they cannot be called cottages—there is an utter want of what we consider “home comforts”; the very expression is a mockery in connection with them and their mode of living. What wonder, then, that beggars swarm in every direction, for the line of demarcation between the very poor and the beggar classes is very slight?

The beggars of most Chinese cities may be divided into three principal classes, each miserable, dirty, and designing, but with differences, which must excite and demand pity in varying degrees. One class, the most numerous, perhaps most powerful, best organized, and most prolific in resources, is under a “head man,” a species of gypsy king. This man is raised to his high dignity on account of his superior talents as a knave and extorter of money. “Whatever the beggars procure by begging,” says

the writer of a Chinese romance, “is given to the head man; and in time of rain or snow, when they cannot follow their calling, their chief provides them with food and supplies them with clothing.”

The head man's duties are to estimate the wealth and resources of the chief shops in the cities, excepting, it is said, those of tailors and other artisans. He goes around to the owners of these shops, and bargains with them until they come to satisfactory terms. Two slips of paper, one green and the other red, are then pasted up in the shop, on which are set forth the head man's name, the amount of blackmail agreed upon, the days of payment, and a warning to the fraternity not to annoy the shopkeeper. The shop is thus protected, for the time being, against molestation by this man's tribe; but if the owner refuses to come to terms, the consequences are disastrous, for a crowd of ragged, filthy, brazen-faced, stentorian-voiced beggars is let loose upon him, and the transaction of business is rendered almost, if not quite, impossible, until at length, in his despair, he gladly agrees to pay a heavier contribution than at first demanded. The payment thus made by large shops is from \$7.50 to \$8.50 a year.

Only men are admitted into the beggars' clubs or guilds, and they all draw from the funds, accumulated as before described, certain stipulated sums, according to their abilities. The ceremonies attending births, marriages and deaths furnish the beggars with great opportunities. If a wedding be going on, they appear, shouting, “Good luck to you! may you grow in wealth and increase in honors! May your halls be filled with gold and precious stones! May you have numerous sons and daughters! Good

luck to you, good luck to you!" On receiving a small gratuity they depart; but only to reappear the next day, and, after the expression of further congratulatory sentiments, to demand the fragments of the marriage feast. Much the same takes place after funeral feasts, and on such occasions it sometimes happens that a considerable sum has to be distributed among the beggars before they will allow the burial or ancestral sacrifice to proceed without interruption. To attain their end, they will even go to the length of getting into the grave and preventing the coffin from being lowered.

The following is a curious use to which beggars are sometimes turned. When a very irate creditor is weary of his debtor's delay, and cares more to annoy the man than to possess his money, he gives his bill to these beggars, compounding, perhaps, for part of the spoils; and sends them day by day to worry the miserable debtor into settling the account. Among their other means of gaining a living, beggars are employed to bury criminals after an execution; others, again, act the parts of shipwrecked sailors, etc., etc., and spread before them on the ground a harrowing description of their supposed sufferings. Some attach wisps of straw to their children, implying thereby that, in consequence of the extreme distress of the parents, they were for sale; though, if the truth were known, it would probably be found that these very children had been before hired to be pinched, and made to cry in order to excite pity.

Another class goes by the name of "high-flower people," but, notwithstanding their high-sounding title, they are decidedly a grade lower than the former class. They live in the outer courts of certain temples, and consist mainly of refugees from other

districts. These poor wretches have their regular sources of income as well as the former class. In the middle of the seventh moon, when sacrifices are offered to the spirits from the tombs, who are then supposed to be maliciously using their brief month's holiday to sow sickness broadcast, these poor beggars come and claim the remains of the feast, which, after all, is but a scanty one.

The third class of beggars is that for which an asylum is provided. This is called by names signifying asylum for the fatherless and distressed, or asylum for relief. These beggars are not able-bodied, like most of the others, but are blind, lame, or maimed, or suffering from wounds, commonly self-inflicted. They often blind themselves to attract pity, when they are too lazy to earn an honest and independent livelihood. Besides actual self-mutilation, of which we could quote numerous instances, these beggars are not one whit behind their European confreres in simulating fractures, wounds, etc., and so crafty and skilful are they, that their devices need very careful inspection before the hideous imposture can be unmasked.

The number of beggars in some Chinese towns is almost incredible; in Ningpo, for instance, a city in which the population is estimated at 115,000, they are said to amount to between 10,000 and 11,000. There is no national system for relieving them, and they are left to do very nearly as they like, no Chinese statesman having as yet had the courage to deal with the difficult question efficiently. In former days, at Peking, the government used to keep up certain small tenements for their shelter, which were called "feather houses," from their being furnished with quantities

of feathers to impart a little warmth to their wretched occupants in the piercing cold of a northern winter.

The Chinese beggar is incorrigible. He seems thoroughly to enjoy his wretched and squalid mode of living; and for the present at least, nothing that benevolent and philanthropic foreigners can do will avail much towards the diminution of mendicancy in the empire. That Chinese beg-

well-paved streets; handsome buildings, parks and gardens; theaters and concert halls; a railway station, and, perhaps, more significant of all, five stone piers, each from a quarter to a half mile in length, and provided with railway tracks, warehouses, and elevators. The Russian Government has shown that the Americans are not the only people who can run up boom towns.

The peculiarity of Dalny, however, is



VLADIVOSTOK HARBOR, THE CHIEF RUSSIAN HARBOR ON THE PACIFIC.

gars are happy in their way there can be no doubt, as witness some of their sayings: "Three years a beggar, who would be a king?" and "The finest rice has not charms equal to roving liberty."



RUSSIA'S PORT ON THE PACIFIC

Twice in the history of Russia has the Czar decreed a city into being. Two hundred years ago it was St. Petersburg, on the banks of the Neva. To-day it is Dalny, off the Yellow Sea, on Talienwan Bay.

In 1889 there was nothing at Dalny except a deep and spacious harbor. By 1902 there was a population of 50,000; broad,

that for a boom town it is suspiciously substantial. It was built with an eye to the future. When three years old it looked more like an old resident than a squatter. It gave one the impression that the Russian "provisional" occupation of Manchuria was a mate to the English "provisional" occupation of Egypt. Both these occupations are not so much provisional as pre-

visional. Dalny means "Far Away." It is about 6,000 miles from St. Petersburg. It has a continuous connection by railway to that city. From St. Petersburg to Dalny by the Suez Canal it is forty-five days. Overland by rail it becomes about fifteen. Almost

the same proportionate reduction can be made in the traffic from Berlin, Paris and London. With that traffic established, steamers will ply from Dalny to Shanghai and Nagasaki. With the route to the Far East via Irkutsk, Russia may begin to recoup herself for the four or five hundred million dollars spent since 1891 in the construction of her Transsiberian Railway system.

The natural advantages of Dalny are striking. The largest ocean-going vessels can steam into the harbor without the aid of a pilot and proceed directly to the new piers. There is no danger of ice blockades at any time. Navigation is clear all twelve months. Port Arthur is only forty-five miles away. Seoul, Wei-Hai-Wei, and other strategic points are not far distant. The commerce of the east cannot fail to

transact a large part of its current through the new ports.

Dalny has no custom-house. According to the Russian authorities, it is to lie open to the merchant marine of the world. It is to illustrate the "open door" idea in its widest sense. The world received this announcement with some misgivings. Shakespeare has expressed his opinion of foolish curs that run winking in the mouths of Russian bears and get their heads crushed like rotten apples. It is never safe to presume too much on Russian inducements. But it is still a free port, and there is no reason why American traders should not enter by the Dalny open door as long as it remains open.

The ultimate fate of Dalny will be a matter of no very little interest. It is not every city founded by rescript or ukase that



WINTER SCENE IN A KIRGHIZ VILLAGE—SOUTHWESTERN SIBERIA.

lives. Such attempts to raise autocratic power above social and economic forces are often futile. The cities of Genghis Khan and other Oriental conquerors hardly survived their builders. Alexandria, on the other hand, has endured to the present day. There is no general rule. Some artificially created cities thrive. Others do not. What Dalny will do, or fail to do in the future will concern all nations that have interests in the Orient, and that means all the great nations of the world.



KOREA AND ITS AWAKENING

The little Empire of Korea always stands with the threat of international warfare hanging over it. The location of Korea has made it a bone of contention between its Asiatic neighbors for many centuries, and when the European powers fixed covetous eyes upon it, its position became even more precarious. Japanese and Chinese influence have struggled for favor in Korea for a long time, although the Chinese strength in the peninsula has been far greater in the past. In 1894, Japanese influence had become dominant at the Korean court and the result of the contentions and jealousies that arose was the war between China and Japan, fought over Korean controversies and upon Korean soil. Since then, the gradually reduced strength of China in all international affairs tended to leave Korea more at the disposal of Japan, until the European powers began to thrust their own interests forward and take a hand in the affair.

Then Russia and England became prime factors in the struggle. The Russians' occupation of Manchuria brought them into

contact with Korea along the whole northern frontier of the little Empire, and gave them an immense advantage in whatever they should attempt. The succession of treaties dealing with affairs in the Orient, by which Japan and Great Britain became allies and France and Russia renewed and emphasized their own alliance, was stimulated no less by the Korean situation than by the Manchurian. Japan yearned to make Korea her own. Russia had Manchuria in her grasp, and it became a virtual moral certainty that the day of relinquishment of the Chinese province would be slow in coming if it ever came. So the threat grew that some day we might see the next great international war upon Korean soil for supremacy in the Orient.

Backward as the little peninsular empire is, its possibilities are considerable and its natural resources important. The people are frugal and industrious like all of the Mongol race, but they have little knowledge of the rest of the world and the progress of civilization. The population varies from 8,000,000 to 16,000,000 and the estimated area is 82,000 square miles. As far as its developments go, Korea is a purely agricultural country and the methods of cultivation are of a backward and primitive type, the means of the communication being few and difficult. Rice, wheat, beans, tobacco, barley, millet and oats, are grown. Gold, copper, iron and coal abound. Transport in the interior is by pack horses and oxen. There are a few telegraph lines in the country, mostly in Japanese hands, a postoffice has been established, and a railway to the capital, Seoul, is under construction by an American syndicate. The Koreans' own name for their country is "the land of the morning calm."



BAYONET EXERCISE WITH OSCILLATING DUMMIES IN THE RUSSIAN ARMY.
These oscillating dummies are placed on the top of entrenchments, which the soldiers scale. After they deliver their blows the soldiers, going through the ranks of their silent victims, place themselves in skirmishing order.

The introduction of western methods and ideas, and the struggle of western powers for control of the country, promise to make that phrase a misnomer before many years have passed.



THE TEMPLES AT NIKKO, JAPAN

At Nikko are the most famous and the most elegant temples, in the highest state of preservation, placed in scenery at once grand and beautiful. These costly works of art are not so much temples to-day as national monuments. No words can convey an idea of their elegance or the richness of their decoration. No European cathedral or palace can compare with them in the latter respect. Of course they lack the majes-

tic proportions of the famous Christian churches, but in variety, originality and richness of ornamentation they surpass the finest production of European builders. Many of them have substructures of stone, but the rich effects are produced by bronze and lacquer work, and by such carving as only Japanese artists have accomplished. The carvings are generally on the exteriors. Many are grotesque but all are full of life and action. In one place there is a frieze of large monkeys, one of which presses his paws upon his lips, another on his ears and a third on his eyes; also a sleeping cat over a gateway, so lifelike that one expects to see her move if disturbed. Outside and inside the most charming harmonies of color arrest the attention.



NIKKO, JAPAN, GARDEN SCENE.

We advance from court to court through these wonderful gateways, finding each more beautiful than the others; and around all and among all the stately cryptomerias, adorning a stone stairway here and stretching to right and left in grand avenues. Nowhere else may one see such combinations of nature and art. As we advance we constantly ascend, opening new vistas continually, and after we leave the last court of the temple there are 200 stone steps, divided into four great stairways, which lead up to the mausoleum of Ieyasu.



BUDDHIST TEMPLE AT NIKKO, JAPAN.

The tomb itself, shaped like a small pagoda, is a single bronze casting of a light color, produced by the admixture of gold. The accessories include a stone table, bearing an immense bronze stork with a brass candlestick in its mouth, an incense burner of bronze, and a vase with artificial lotus flowers and leaves in brass. Turning from this, we pass on to other temples, through other stately avenues and spacious courts, to the mausoleum of Iemitsu, equally beau-

tiful, though less profusely decorated. You must imagine those peculiar temple gates of granite and bronze, great stone lanterns, huge bells, stone fountains, so finely leveled that the water flows over every inch of their circumference in a silver film, the rich colors of the bronze and the lacquerwork, the latter sometimes vividly red, leaping cascades, colossal sculptures, and, above all, the enormous trunks and the graceful foliage of the trees. To see the temple on a moonlight night, the vision of beauty is far beyond any dream of fairyland. The

floors of the temples are either shining with lacquer or covered by immaculate mats, and the visitor is obliged to remove his boots at the threshold, putting on a pair of soft-soled slippers. These structures extend over hundreds of acres, and there are miles of stately avenues. The amount of human labor expended here, and generally labor of a high order of artistic skill, is sometimes enormous. The richness

of the materials used is also to be considered. It is estimated that these temples could not be reproduced to-day for \$50,000,000. They are visited by thousands of pilgrims, who show all the outward forms of devotion. Certain it is that the opportunity to see such works of art must be an esthetic education.

The ethical instruction is rude, but it seems to include all that is considered essential by the great body of Christians.

They have a supreme god, Amida, and many subordinate deities, to whom they appeal for special blessings. They have a system of rewards and punishments after death, and the most elaborate philosophy of prayer. They are taught deference, charity, kindness, honesty, veracity. The result of this teaching is a kindly, urbane, docile people, comparing favorably in all the fundamental virtues with any western people.



SECRET SOCIETIES IN THE PHILIPPINES

Where large numbers are in deepest sympathy with a given political movement, and when to espouse that cause means persecution or death, it may be certain that there will be a conspiracy under the protective oaths of a secret society.

Under the oppression of Spain, the Katipunan society was formed in 1894, by Dr. Jose Rizal, the martyr, patriot, hero and poet of the Philippines. Within a year it



AMERICAN SOLDIERS IN THE PHILIPPINES.

enrolled 50,000 sworn able-bodied men as members, and by them was fought the stubborn war against the Spaniards until the battle of Manila. This society was simply a modified form of freemasonry. Father Coleman, an American priest of the Dominican order, long in the Philippines, says this:

"Freemasonry, as the world knows, has been the principal cause of the social disorder in the Philippines. The Masons instigated the natives to make war on the clergy and the Spaniards."

The hostility may be estimated by the fact that there were at one time 3,000 Masons in dungeons at Manila. In order to free Masonry from the political stigma, the Katipunan society was organized. Its ceremonies were of a dread and impressive character, full of oriental mysticism, designed to impress the initiate and direct his vengeance against the usurpers. The sign of the order was the scar from an incision in the left forearm or below the left knee, and with the blood therefrom, or with blood pricked from the third finger of the left hand, the constitution was signed. It was



FILIPINOS IN MANILA HOSPITAL.

very similar in its operations to the Carbonari of Italy.

Dr. Rizal was at last suspected of being at the head of the society. He was arrested and shot, while the band played rollicking airs and the Spanish ladies looked on and applauded. It was on Dec. 6, 1896, when he was led to execution from the side of a lovely girl who was made his bride while the soldiers were loading their muskets.

From Spanish persecution she was compelled to fly to the camps of the insurgents, where she was well nigh worshipped as the wife of their martyr-hero. In the bloody battle against the Spaniards at Silan she led the last charge, but they were driven back by the superior numbers and arms. Since 1900, she has been in charge of one of the public schools in Manila.



BORNEO AND ITS WHITE RAJAH

Borneo is a little larger than the state of Texas, and was the home of the worst savages of the Malay Archipelago. The interior of Borneo was long ruled by the Dyak head-hunters, who were docile, friendly and trustworthy beyond many of the other Malays, but whose religion taught them that every person they decapitated would be their slave in the next world.

At the opening of the nineteenth century, there was a fierce rivalry among the maritime nations for the control of the pirate-infested islands of the Malays, on account of the spice and coffee trade. The first compromise was that the Dutch were left unmolested in Java, the English held Malacca and the Malay peninsula, while Sumatra, Borneo and Papua were left to the savage natives.

In 1838 the son of an English clergyman, being of an adventurous spirit, sailed up one of the many small streams of Borneo with a little schooner having about a dozen sailors. He was burning with the ambition to emulate Pizarro and Cortez. He had the courage, for he had been wounded in one of the desperate battles of India, decorated for bravery and discharged on a pension before he was twenty-one. Fate caused him to land at Sarawak, which was governed by an old rajah who was apparently about to be overwhelmed by the Dyaks.

The young man's chance was here. He offered to conquer the Dyaks if the Rajah would make him general over all the military forces and direct heir to the throne. The Rajah had no intention of keeping his word, but all that was asked by the Englishman was solemnly promised. Young Brooke put each one of his sailors over an equal force of natives and soon succeeded in crushing the power of the Dyaks. The Rajah then ordered Brooke and his men to leave the territory, but Brooke appealed to the Sultan of the islands to confirm the justly-won promises. To the surprise of the English, in reply a courier came from Kuching, the capital, who proceeded to dismiss the old Rajah and to install Brooke in his place. The Englishman now had his wish and was king of Sarawak.

The head-hunters soon became his most devoted subjects. However, his people lived by piracy, were polygamists and slaveholders, therefore his task of Christian government was an appalling one. In five years he had civilized the people as far as justice was concerned, and had established a system of schools, churches and courts. At the end of ten years there was not a nook or corner in his dominions which was

not yielding him faithful allegiance and obedience.

Then he visited England, where he was the lion of the day. He was banqueted by boards of trade and given the freedom of the cities. He was lodged in Balmoral Castle and knighted by the Queen. He died in 1868 and was buried with great honor in England. His nephew, who had been his faithful companion for many years, succeeded him and is now the white Rajah of Sarawak.



THREE CENTURIES OF WAR IN THE EAST INDIES

A war that has been going on for 300 years, is the conspicuous fact in the history of the Dutch colonies in the East Indies. Lying to the southeast of Asia, and extending almost to the Australian coast, is that great archipelago of tropical fertility which has contributed so generously to the wealth and prosperity of the little kingdom of the Netherlands. The total population of the Dutch East Indies, according to the last returns, is approximately 35,000,000, or seven times as great as that of the mother country, while the area is about 735,000 square miles, or more than sixty times that of Holland itself. It was in 1602 that the Dutch created their East India Company, which conquered the islands and ruled them during nearly two centuries until in 1798 the company dissolved and government was assumed by the Dutch kingdom. There are a dozen or more of the islands of which the area much exceeds that of Holland itself. Java, Sumatra, Borneo, Celebes, and New Guinea are the more famous of these great tropical islands, but of these Borneo and New Guinea are not en-

tirely owned by the Dutch, as Germany and England have large possessions there also.

In spite of the schools, the churches, the increased commerce and prosperity of the islands, the careful administration of justice and the honest and intelligent colonial government to which Dutch publicists point with pride, they have not been able in three centuries yet to overcome the resistance of large elements of the native population to alien rule. For three centuries the Dutch have been in absolute control of the islands as far as their relations with other countries are concerned, directing all of their industrial and agricultural development and maintaining authority by a large colonial army, partly brought from Holland and partly recruited from the friendly native races. In spite of this long period of control, there are large areas in these great islands which are pacified only as far as the range of the Dutch rifles extends. They have garrisoned military posts at intervals, and the territory immediately surrounding these posts is peaceably accessible to the Dutch tax collector and safe for the visit of the traveler. But in the depths of the tropical forests, out of reach of protection from the soldiery, the white man is not safe. These races who have been fighting for their freedom from Dutch rule for 300 years of bitter and oftentimes cruel warfare, are akin to the Moros and the other more warlike tribes of the Philippine Islands. It is not a pleasant prospect for us to face in contemplating the course of our own history in the Orient, as it is to be developed within the next few years, but inasmuch as this experience of the Dutch harmonizes so exactly with that of the Spanish who had been themselves fighting in the Philippines for as long a period, the lesson should not



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QUININE (CHINCHONA LEDGERIANA) TREES (PERUVIAN BARK).

It is these trees which produce the Peruvian Bark, or Quinine of Commerce.

be lost upon us. Holland has poured millions of dollars into the effort to subdue their rebellious subjects in the East Indies, and although the tropical products which have brought wealth from the colonies to the little kingdom have more than compensated this money cost, there are thousands of killed and wounded and diseased soldiers every decade to be reckoned as the largest item in the price of colonial power in the Orient.



THE UNITED STATES OF AUSTRALIA

With the first year of the twentieth century, a new commonwealth was born into the family of nations, so nearly a nation itself as to justify a warm welcome into the sisterhood. Away down in the South Pacific Ocean, the British Colonies which have been known as Australasia have federated, and have formed a great union not unlike the union of the American Colonies into the United States of America. The only one of these far-away colonies omitted in the consolidation, is New Zealand, which lying more than a thousand miles to the eastward of the Australian continent, and having many diverse interests, decided that in its case independence was better than union. In the Commonwealth of Australia, therefore, are united the five continental colonies of New South Wales, Victoria, Queensland, South Australia and Western Australia, and the little island to the southward of the continent, called Tasmania. In organizing their government, these federated colonies went through many of the same difficulties and faced similar problems to those that were solved by our own colonial fathers in the days when they were organizing the

union of the states from the federated colonies. Meeting the same conditions as they did in many details, the Australian statesmen studied with care the form of the American government and used our political history to draw from it such lessons as were applicable to their own situation.

As with us, the individual colonies thus becoming the states of the Commonwealth of Australia retain their own control of their own internal affairs, simply yielding such functions to the national government as can best be administered by the general organization. As in our country, each state has its own governor, local legislature, executive department, and judiciary department. As with us, too, the national government of Australia has the same organization of two legislative bodies, an upper and a lower house, in its parliament, and its own executive department and courts for national affairs. One conspicuous difference, however, comes from the fact that in Australia, as in most other free countries except our own, parliamentary government exists above the executive, and a changed majority in parliament requires the change of executive and the formation of a new ministry or cabinet.

In our own country, as is, of course, clearly understood, the President and his cabinet of personal appointees may and do hold office through the term of his election, irrespective of the partisan character of congress, or the changing opinions of the country at large as expressed in intervening elections. This, therefore, results in the condition that the President may be an adherent of one political party, while congress has a working majority of the opposition. Under such circumstances, legislation becomes virtually blockaded, for the legisla-

tive and the executive must be in agreement under our system, before legislation can find its way to the statute books.

This kind of a deadlock cannot occur in a country which is governed by the parliamentary system, with what is known as a responsible ministry. The governor-general in such a country as Australia is not, in fact, the executive, but a virtual figure-head, with important social and personal functions, but little influence and no authority over the affairs of the country. When parliament is elected, with a certain political majority of one party or the other in control, the governor-general calls the recognized and admitted leader of the party in control and delegates to him the formation of a ministry. The leader thus designated becomes the premier, and may at his own choice assume whatever portfolio in the cabinet he desires. In effect, the premier then becomes the chief executive of the country, and remains so until a parliamentary majority should be cast against some measure which he proposes or in the form of a vote of "no confidence." When that occurs, he must resign with his cabinet, when the leader of the opposition which has now become the majority is in turn called to form a ministry. The alternative before a premier thus defeated in parliament, instead of resigning, is for him to "appeal to the country," as the saying is, by calling a new election. In the event that he is sustained by the popular verdict in his favor, as would be demonstrated if a majority of parliament again voted in his support, he would still hold his office.

The fact that the premier and all his fellow members of the ministry must be members of one or the other house of parliament, serving in their places as do the other

members, makes it possible and necessary for them to enter into debate when measures are under discussion to support their parties' position. At the same time they are more readily subject to be questioned and criticised by their fellow members of parliament than they would be if they were at long range, sequestered in their department offices. It is evident that the Australian system, or, more broadly speaking, the system of responsible ministries and parliamentary governments, makes the legislation of the country and the acts of the executive much more promptly amenable to the public will than can be true under our own system, where both legislatures and executives are elected for a fixed term of office. Whether or not this is an advantage may be left to the individual judgment of the reader. Beyond question, there are points in favor of both systems.

The Australian Commonwealth is going through difficulties in the way of selecting a capital not unlike those which our own republic faced in its young days. Just as New York, Baltimore, Philadelphia, and our other important colonial cities strove for the honor, so have Adelaide, Melbourne, Sydney, and Brisbane sought for the distinction in Australia. And just as with us a compromise was effected, a new site chosen where no city was, and a new federal district created to be entirely under the control of congress and not subject to the authority of any state, so Australians have solved their problem. They have decided that the federal capital shall be within the State of New South Wales, which is known as the mother colony of Australasia, but not within 200 miles of Sydney, the metropolis of the continent. Until the final selection of this favored spot shall be made,

Melbourne is to be the commonwealth capital temporarily. The presumption is that Albury will be the fortunate town selected for the permanent capital. Albury is a picturesque and thriving town on the banks of the Murray River, which here forms the boundary between New South Wales and Victoria, the two most populous colonies. The railway systems of the two colonies meet here, and a great railway bridge unites them. Here will be established a federal district under parliamentary control, not subject to the government of either state, and here, if Australian expectations are fulfilled, will grow up a city to rival our own Washington in its architectural beauty and political importance.

A new nation not only needs a constitution and a capital, but a flag as well, and the choosing of the emblem aroused the utmost interest throughout the commonwealth. A prize of \$1,000 was offered for the best design, and more than 30,000 suggestions came in to the office where the competition was directed. The difficult task of making a final selection was entrusted to a committee of naval experts. The same design had been submitted by five competitors, so that each received \$200 as his share of the award. The Union Jack occupies the upper corner of the flag, at the staff. A large six-pointed star under it denotes the six states of the federation, and the Southern Cross, that beautiful constellation known to every traveler in the southern hemisphere, is marked on the other end of the flag. This new flag is one with which we are likely to become familiar, for the trade between Australia and the United States is increasing with great rapidity. The Australians are among the most enterprising of people. They have a continent of enormous re-

sources, hardly beginning to be developed, and their commerce is the largest, per capita, of all the countries in the world, so that we are quite justified in maintaining the most cordial relations with our neighbor commonwealth in the South Pacific.



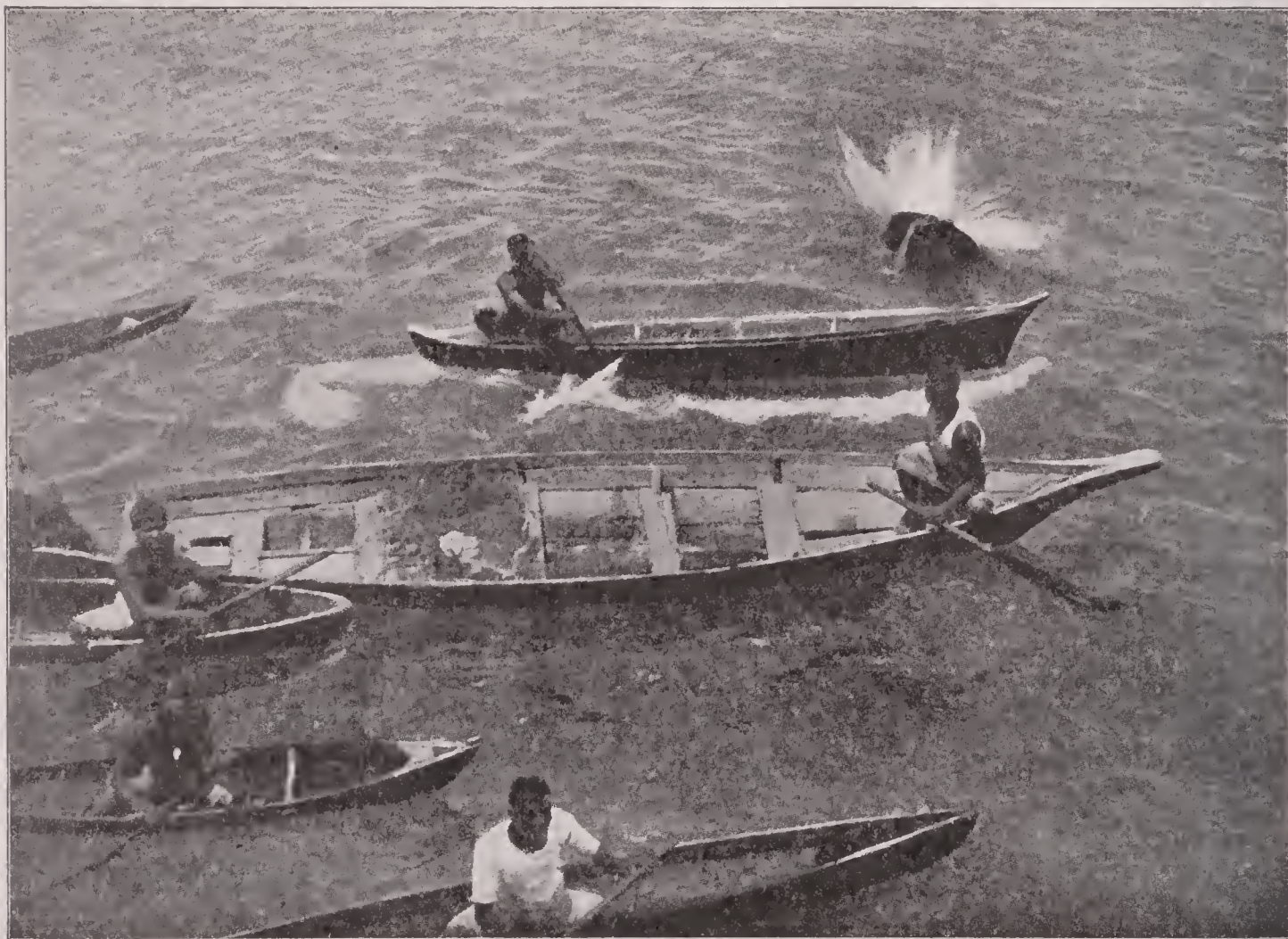
NEW ZEALAND, THE LAND OF LIBERAL LAWS

We are accustomed to speak of China and Australia as the antipodes, and yet, as a matter of fact, those countries are not our antipodes at all. The exact opposite to the central portion of the United States of America is found away down in the Indian Ocean, about half way between Australia and Madagascar. Down in the South Pacific Ocean, however, is the island colony of Great Britain named New Zealand. The people of New Zealand like to call their country the Great Britain of the south, and there are many points in common between the two countries which suggest the parallel. New Zealand, like Great Britain, is an island country, composed of two large islands, virtually the exact geographical antipode of Great Britain itself, and with the population as entirely English, Irish, and Scotch, as are the British Isles. Even the manners of life, the industries and the products are very similar, and the climate itself of New Zealand is not unlike that of Great Britain, although slightly warmer both in winter and in summer.

One detail in which New Zealand is a genuine opposite of Great Britain is in its legislation on industrial and financial questions. New Zealand is as radical as Great Britain is conservative, and the island colony has been called by one student "the

economic laboratory of the world." The youngest of Great Britain's self-governing colonies as it is, New Zealand has made practical trial of a great many experiments in social reforms which people elsewhere have been contented to talk about. In the more conspicuous of these successful experiments, is the prevention of strikes by the compulsory arbitration law. In the period of seven years since compulsory arbitration was put into practice, the country has prospered and profited by it to a remarkable degree. In every detail the prophecies of failure have been contradicted. In the beginning the opponents of the law declared that nobody would submit labor disputes to

a court for settlement; but instead of that, everybody has been ready to appeal to the law at the first sign of difficulty. It was declared also that no one would submit to the judgments of the arbitration court except the ones who were favored by the decisions. Yet in practice it has proved that the rulings of the courts have been accepted by both parties alike. It was prophesied, last of all, that such an experiment would cause the withdrawal of capital, the destruction of the credit of the country, and the collapse of its infant industries. Instead, exports have increased 35 per cent per capita in the seven years, the number of persons employed in factories and workshops



CAUGHT BY A SHARK; THE FATE OF A DIVING BOY.

At Aden on the Arabian coast, as in other tropical ports, boys come out to the steamers in harbor to dive for pennies which passengers throw into the water. Sharks infest the water. The snapshot was taken just as a great shark seized a diving boy and the horrible scene is clearly depicted. The boy's companion is horror-stricken, but the others do not know yet what has happened.

has doubled, and the increase of wealth and prosperity has not been confined to a few capitalists, but the mass of the population has reaped the benefit. In the seven years the number of persons with money in the savings bank has increased from 150,000 to 240,000, and the savings have increased from \$20,000,000 to \$35,000,000.

Of course not all of these improved conditions can be credited solely to the arbitration law, for New Zealand is progressive in its legislation in other ways. Nevertheless this law has been a most effective influence in removing the causes of strife between employer and employees, and New Zealand has become virtually a country without strikes. New Zealand likewise has an old age pension law, government life insurance, compulsory sale of real estate when wanted for settlement and postal savings banks.

Four out of six state Parliaments of Australia have adopted similar laws after observing the good effects of the New Zealand act. It is declared by New Zealanders that in the seven years this great social and economic experiment has substituted peace and good feeling for industrial war and bitterness; has converted a large majority of its bitterest opponents into supporters; has steadily and with amazing rapidity increased the production of the colony and the wealth of all classes of its people; and finally has so impressed the people of the countries nearest to it and best able to judge of its effects, that they are one by one adopting its provisions for themselves. Inasmuch as the relations of capital and labor form one of the most conspicuous problems which we have to face in this country, it is important to observe the results of such experiments elsewhere as may throw light upon our own puzzles.

TUTUILA, OUR SAMOAN ISLAND

One of the smallest of American island possessions in the tropics, although not the least interesting, is Tutuila, in the Samoan group. There is one feature about the American ownership of this little island in the South Pacific which makes it noteworthy among all our outlying dependencies. This is that the people are without exception friendly to the United States, their friendship having been established during years of international jealousies and strife over the possession of the group, during which time this country always stood for the natives themselves, as against those who would absorb their country.

The Samoan Islands lie some 2,400 miles southwest of Honolulu and 1,600 miles northeast of Auckland, New Zealand. Apia, on Upolu, the largest island, has been the capital of the group and the chief commercial town, being the port of call for steamships and the place where all of the white traders made their headquarters. At the same time it was the center of the factional fights between the rivals for the Samoan throne, and consequently for the machinations of the powers seeking foothold there. Robert Louis Stevenson, who sought the restoration of his health in this balmy island, and remained there until his death, has written of these political struggles in a book called "Eight Years of Trouble in Samoa." Here in the harbor of Apia occurred that disastrous hurricane fifteen years ago, which resulted in the loss of three German and three American men-of-war, and the death of a large number of sailors of the two navies.

But now apparently the warlike troubles of the Samoans are over. They have lost

their political identity as a nation, as the price of peace and protection from two great governments. The United States acquired the little island of Tutuila, and to Germany the rest of the group was ceded. It is on our American island that we already had important rights gained by the treaty with the Samoans themselves thirty years ago. Here is the harbor of Pango-Pango, the best harbor, so navigators declare, of any in the Pacific Islands. Here we established a coaling station and a naval supply station. Here, too, is the port of call for transpacific steamers plying between San Francisco and Australia. As the years pass, therefore, Apia will lose its importance to Americans and Pango-Pango will rise. The island of Tutuila has an

area of about seventy square miles and a population of 4,000. Tropical vegetation of all kinds grows luxuriantly, and the only commerce of importance is the export of tropical fruits and their products, most important of which is copra, the dried meat of the cocoanut, from which cosmetics and toilet preparations are made.

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HAWAII, "THE PARADISE OF THE PACIFIC"

Among its other great possessions the United States now claims ownership of the largest of all volcanoes in the world. Out in the Pacific Ocean, 2,000 miles southwest of San Francisco, lies the Hawaiian group of thirteen islands, the eight larger



GRASS THATCHED HOUSE IN TAHITI—SOUTH PACIFIC OCEAN.

of which are inhabited. Here in the tropics are the first of the American possessions in the Pacific to be reached by the traveler visiting Asia or Australia. They lie in placid waters, and the tropic breezes that blow around them are balmy, but their history has been disturbed by many a conflict until the time they came into American ownership. It was here that Captain Cook, the great English navigator, lost his life at the hands of the natives, shortly after he first reached the islands in 1778. The native royal house lost its control in 1893, when the last queen, Liliuokalani, was deposed and the republic succeeded the monarchy.

The American influence has been strong in the islands for many years and their trade has been almost entirely with this country. Successive efforts to arrange an annexation failed in turn, until in 1898, during the Spanish-American war, the islands were formally annexed to this country. A year later Hawaii was created a Territory of the United States and the Honorable Sanford B. Dole, who was the President of the Republic, was made the Governor of the Territory. Honolulu, with a population of some 40,000, is the largest city, the capital, and the chief commercial port. The products of the islands are those common to the tropics, but the chief industry is the raising of sugar. The sugar production for 1901 was valued at more than \$27,000,000. The other articles of export are coffee, hides, fruits, wool and rice, but the total of these does not amount to \$1,000,000. The population of the territory has been decreasing ever since the discovery of the islands, until about ten years ago, since which time it has increased rapidly by immigration. The total population

now is nearly 160,000. Of these the native race and the Chinese, Japanese and Portuguese form by far the larger portion, and the natives are steadily diminishing in number.

Here in the Hawaiian Islands are the largest of all volcanoes in the world, both active and extinct. Mauna Loa, Mauna Kea, and Kilauea are the greatest of these, and the eruptions which occur at intervals are splendid spectacular sights which attract visitors in great number from the United States to witness the display. Mauna Loa is 13,670 feet above the sea level and has several craters in the great basin of the top, the terminal one being a little more than a mile and a half across, a veritable sea of molten rock, by far the largest in the world. Eruptions sometimes take the form of enormous fountains. One in February, 1859, was a sheaf of white-hot fluid lava two hundred feet or more in diameter and about 300 feet high, which illuminated the country around to a distance of 150 miles.



THE LEPER ISLAND OF MOLOKAI

A land where one does not have to pay taxes or rents, and where a beneficent government provides cottages and rations, herds and clothing, and where not only blankets but even medical attendance are without cost, is not this a veritable Utopia? Yet such a land is our nearest neighbor in the Pacific, and is only some 2,000 miles distant. As one's steamer leaving San Francisco approaches the Hawaiian Islands, before it can drop anchor in the beautiful harbor of Honolulu, it must needs pass Molokai.

And Molokai? Why, that is the fifth is-

land in size of the entire group of the Hawaiian or Sandwich Islands, and is some forty miles in length with an area of about 200,000 acres. On its eastern side are elevations of fully 2,500 feet, while on its western slopes they diminish to a height of about 1,000 feet. Its valleys are beautiful and are filled with deer. A herd of spotted deer, presented by the Mikado of Japan some thirty years ago, were placed by the King of the Hawaiian Islands on Molokai, and now number some 3,000, roaming at will over a large part of the island. Here are many kinds of the most luxuriant tropical vegetation, the balmiest air, the most invigorating sea-breezes, even such spicy breezes as blow soft o'er Ceylon's isle.

But though every prospect pleases, few persons can be induced to make their home on Molokai. The entire population is only some three thousand, and at the last census 1,120 of these were lepers. Possibly nowhere in the world is the census more carefully taken and more accurately known than is the case here in the northern part of the island. Molokai, as is well known, is the name for the leper colony of Hawaii. The lepers do not occupy all the island, but only a grassy plain, a mile in length, on the north side of the island, and yet separated wholly from the rest of the island and its population by a precipice fully a thousand feet high, which can be scaled at only one point, and here it is securely guarded.

Despite their freedom from taxation and rents, their ample supplies of food and clothing, their abundant herds of cattle and horses, and their fertile fields which require so little labor, the lepers are virtually life-prisoners, shut in by the ocean on one side and by the impassable mountain on the other. Most of the lepers are natives, but

foreigners are found among the colonies, and all who once come to this part of Molokai, save to bring supplies or to inspect, as the Board of Health twice each year, do so with the expectation of never returning. At a cost of some \$10,000 per month, the Hawaiian government maintains this open-air leper hospital in order to perfectly quarantine and thus finally stamp out leprosy among the Sandwich Islanders. Sheltered from the strong sea wind, this plain of Kalaupapa would make an ideal place of residence, alike for its beautiful surroundings and the salubrity of its climate; and here everything is done, compatible with preventing the spread of the disease, to make its unhappy victims contented.



ROBINSON CRUSOE'S ISLAND, JUAN FERNANDEZ

Juan Fernandez, of Robinson Crusoe celebrity, is a small island in the South Pacific, some four or five hundred miles west of Valparaiso. Besides the name by which it is more usually known, it is also called Mas-a-Tierra (nearer-the-mainland), to distinguish it from another island nearly a hundred miles farther west, and hence bearing the name of Mas-a-Fuera (farther-off-shore). It has one anchorage, Cumberland Bay, and there, facing the sea, is the settlement, consisting of a few huts and a ruined fort. The island appears to be of volcanic origin; and the huge masses of rock, piled one upon the other, rising to a height of nearly 3,000 feet, present a very picturesque appearance from the sea. Gentler attractions are, however, not wanting; there are at least two valleys rich in vegetation, and smiling with the luxuriance of an almost tropical fertility.

The chief interest of Juan Fernandez lies not in its external features, but in its eventful history, and in the legends which have gathered round its name. That name is derived from a hardy Spanish sailor who discovered it about the year 1563, and promptly obtained a grant of his "find" from the Spanish government. Here, like his more famous successor, Selkirk, he lived for a time "monarch of all he surveyed."

When next the curtain lifts, the island appears as the shelter of the bold buccaneers. It lay conveniently near to the Spanish settlements, for on Spain the buccaneers made war with savage ferocity.

In October, 1704, the "Cinque Ports" galley, one of Dampier's squadron, called at Juan Fernandez. There was a quarrel between Captain Straddling and his sailing master, Alexander Selcraig, or Selkirk, a native of the little fishing town of Largo, in Fifeshire, who refused to serve longer with his captain, and asked to be put on shore. When, however, his wish had been complied with, and he was left alone on the beach with some scanty stores, his heart misgave him, and he sought earnestly permission to return once more on board. But the brutal commander only made this change of resolution a subject of mockery, and left him to the charms of solitude. These Selkirk "enjoyed" for nearly four years and a half, till he was taken off in February, 1709, by Captain Wood Rogers of the "Duke" privateer. Selkirk was appointed mate of the "Duke," and died (1723) lieutenant of the royal ship "Weymouth." A monument was erected to his memory in his native place in 1885. Two circumstances have conspired to confer on this young Scotchman a kind of immortality; Cowper made him the mouthpiece for

a charming poem; and Defoe's immortal story of Robinson Crusoe was suggested by his adventures, although the island of Tobago, off the mouth of the Orinoco, more nearly fits the geography of the story.

The Spaniard Ulloa, who visited the island in 1743, urged the Spanish government to fortify the island and convert it into a penal settlement and his advice was followed. When the South American revolution broke out, many of the Chilean and Peruvian patriots were condemned to exile here. At the end of the revolutionary wars the Chileans took over the settlement, and in 1819 established another penal colony. Again, in 1828 and 1833, convict settlements were formed; but the cruelties practiced on the prisoners led to outbreaks, successful in two instances. At length in 1835 the great earthquake destroyed the fortifications, and the convict establishment was finally abandoned. But the traveler who climbs the brow of a hill fronting the harbor, barely half a mile from the landing place, will still find the melancholy traces of these habitations of cruelty. The face of the cliff is excavated to a distance of several hundred feet, and long winding passages lead to the dark and dripping cells.

Since 1835, the Chilean government has leased the island to private speculators; and in 1868 it was purchased by Robert Wehrdan, a German engineer, who has established a small but thriving colony. In addition to tillage and stock-raising, hunting and fur-sealing, some trade is carried on with passing ships, especially whalers, which often put in for water. In the same year the British ship "Topaze" visited Juan Fernandez, and erected a tablet to the memory of Alexander Selkirk at a spot known as "Selkirk's Lookout."

IN THE FALKLAND ISLANDS

One of the most remote and least known of the island colonies of Great Britain is the little archipelago called the Falkland islands. These islands are situated far in the South Atlantic ocean, about 300 miles east of the Straits of Magellan and about the same distance from the southernmost tip of South America. The islands were discovered in 1592, and belonged successively to France and Spain before becoming finally a British possession in 1833. The area of the group is 6,500 square miles, of which East Falkland contains 3,000 and West Falkland 2,300 square miles. The remaining 1,200 square miles are divided among about 100 small islands. The island of South Georgia, lying some 900 miles east of the Falklands, with an area of 1,000 square miles, but virtually uninhabited, is attached to the same colony for government purposes.

The Falkland islands are treeless, but are well covered with grass. The climate is healthful, though bleak, and the cold winds and fogs from the Antarctic ocean frequently enshroud the islands. The temperature in the summer ranges from forty degrees to sixty degrees, and in the winter falls much lower. The highest elevation is Mount Adam, 2,315 feet. Sheep farming is the leading industry, the flocks numbering about 750,000. Wool, hides and tallow are exported, and provisions, wearing apparel, timber and machinery are imported. The population numbers about 2,100 and the chief town, Stanley, has something more than 700 inhabitants. The government is administered as that of a crown colony by a governor sent from England, who is paid a salary of \$6,000 a

year. He is assisted by an executive council and a legislative council. The little colony is fairly prosperous, with exports amounting annually to more than \$600,000, and imports about half as much. There are government and religious schools, with a total of some 250 scholars. There is a volunteer military company of forty-four members, and a postal savings bank with more than 300 depositors. The colony is attached to the International Postal Union, and about 15,000 letters and post cards pass through the mails annually. Three or four vessels call every month, mostly for the exports of wool and hides to be shipped, although some of them are whaling vessels, cruising in the Antarctic ocean. The government of the colony lives within the income from import duties and rents of crown lands, and altogether the people of the islands do not feel either isolated or in ill luck in their far away island home.

**EASTER ISLAND AND ITS
STRANGE RUINS**

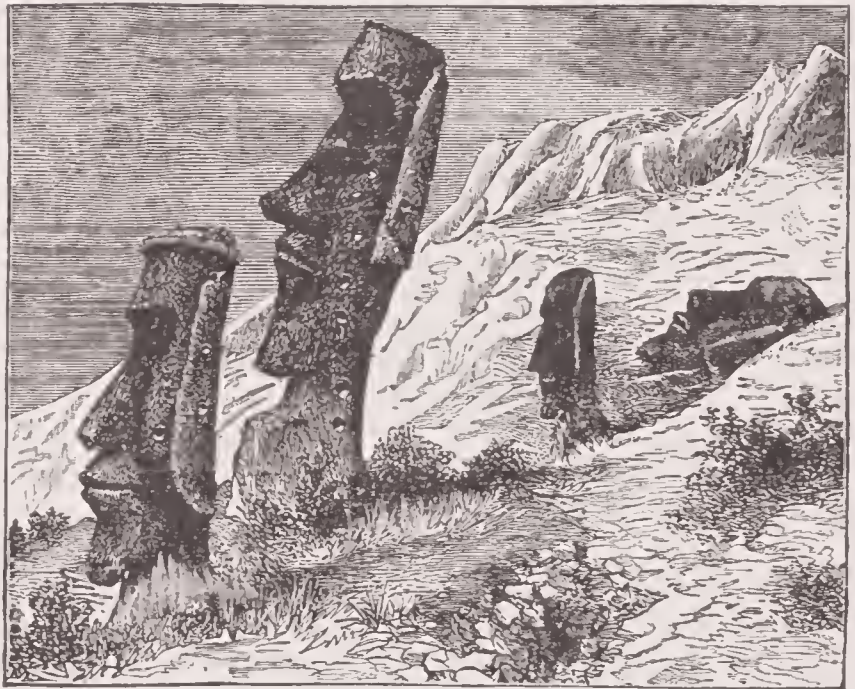
Easter island is considered to be the loneliest island in the world, by those who have cruised every ocean. Its name was given to it by the explorer who discovered it on a certain Easter Sunday, some centuries ago, but it is also the most eastern island of all in the South Pacific ocean. It is distant from the South American republic of Chile, to which it belongs, about 2,000 miles, and from its nearest island neighbor in any direction, more than 1,000 miles. Isolated thus as it is, it is seldom visited either for business or pleasure, although the few scientists who have journeyed to the island on voyages of discovery

report it to be one of the most strikingly interesting places in the world.

Easter island is hardly more than the crater of an extinct volcano, yet its valleys are very productive and the people are easy-going and indolent. Lying so far out in the South Pacific ocean, and just outside the tropics, the climate is mild and equable. On this remote island are some of the most remarkable stone ruins known in the world. They appear in the shape of large stone houses with walls five or six feet thick, making a remarkable contrast with the light huts of reeds built by the natives to-day. These houses have been lined with large, flat stone slabs, on which are painted and sculptured figures of fabulous birds and animals, and huge geometrical figures. Near these houses the rocks are carved with odd human faces, sea turtles, and all sorts of devices and inscriptions. These ruins are quite as interesting as those of Egypt or Central America, and the people who dwell upon Easter island now not only know nothing of them, but have no traditions to account for their presence.

In addition to these ruins, giant monuments have been found cut from solid rock, usually in the form of a human bust and head. These line every prominent headland where suitable rock for carving could be found. Toward the east are immense walls and terraces, the stones of which are large and ingeniously fitted together without cement. The terraces are usually lined with statues, one of which is thirty-seven feet high, and cut out of red stone found only at a point three miles distant. How

was it transported and set up? Who were the sculptors? Is this lonely island a foot-step of some ancient American family on its way across the Pacific toward Asia, or is it an antique camping ground of some colony from Thebes and Nineveh on their way to America, who drew their artistic inspiration from the sculptures of the Nile or Euphrates? How shall such questions be answered? If the truth about the past of this mysterious island is ever learned, some strange puzzles will be solved.



STRANGE STONE FIGURES ON EASTER ISLAND.

THE MUTINEERS OF THE "BOUNTY"

One of the most interesting colonial experiments the world has ever seen was that which followed the famous mutiny on board the ship "Bounty," more than 100 years ago. The mutineers, under the leadership of a man named Fletcher Christian, turned the captain and the officers of the ship adrift in midocean and landed on Pitcairn island, which is several hundred miles southeast of the Society group. They were

not heard of for many years, until by chance a ship called at the island and found it peopled with industrious, thrifty and peaceful settlers, living in contentment, and holding themselves in this isolation as a British colony. The original mutineers had married with the native women whom they had taken to the island. It was too late to punish any one for the mutiny so long past, and the settlers were left to live in peace upon the island which they had made their home.

Some time later, Pitcairn island was so unfortunate as to experience a disastrous hurricane, which destroyed houses and crops and left the islanders in great distress. The island itself, indeed, is little more than an immense rock with not much ground available for cultivation. About the middle of the nineteenth century, Great Britain ceased to use the Australian colonies as a place for the exile of criminals from England, and so vacated Norfolk island, which lies northwest of New Zealand, and had been the settlement for hundreds of the worst criminals. Great Britain, therefore, sent a ship to Pitcairn island and took the colonists from there to Norfolk island, a fertile and beautiful place, where they were given the use of all the buildings, prison and otherwise, that had been so fortunately vacated.

The Pitcairn islanders, however, did not rest contented there. They were homesick for their lonesome rock more than 2,000 miles to the eastward, and finally the greater number of them returned to it, a few years later, where they still live as one of the happiest, most peaceful and industrious colonies to be found anywhere in the world. Some of them still remain on Norfolk island. Both these islands are at-

tached for government purposes to Australia. Norfolk island has an area of ten square miles and a population of 750, while Pitcairn island, with an area of three square miles, has a population of 120.



FRENCH ISLANDS IN THE PACIFIC OCEAN

All of the European colonial powers in the last century have become rivals for island possessions in the South Pacific ocean, although Great Britain is far ahead in the race for the tropical archipelagoes. France stands second in the contest, with some half a dozen island groups scattered throughout the Pacific. The best known of these French colonies are New Caledonia, the Marquesas islands, and Tahiti in the Society group.

New Caledonia was discovered by Captain Cook, the great navigator, who was afterwards murdered by natives in the Hawaiian islands. From the time of the discovery, in 1774, until the middle of the next century, it was apparently regarded as not a desirable island to steal from the natives. The soil offered but little inducement, and the presence of mineral treasures was not suspected. Some French missionaries had labored among the natives, and this gave the excuse to France for seizing and colonizing the island in 1853. The real purpose of the French in hoisting their flag here was to establish a penal colony for convicts, as England had done with Australia and Tasmania. The introduction of a criminal population made the work of the missionaries doubly difficult, but the convicts themselves, under the direction of the authorities, were required to cultivate the

island resources so that the colony became somewhat productive and prosperous before many years had passed.

The area of the island is about 6,000 square miles, and its length from northwest to southeast is nearly 250 miles. Attached to it for government purposes are the Isle of Pines, the Loyalty archipelago, the Huon islands, the Chesterfield islands and the Wallis archipelago, all unimportant groups belonging to France in that part of the Pacific ocean. The population of New Caledonia is something less than 55,000, of whom the natives number nearly 30,000, the convicts more than 10,000, and the military about 1,500. Coal and other minerals are worked, rough ore, nickel, chrome and cobalt being largely exported to Europe and Anstralia. About 1,900 square miles are set aside for natives and colonists; 600 square miles of land suited for agriculture or pasturage remain uncultivated; the rest is mostly forest or mountain. Wheat, corn, and other cereals are cultivated, as are also pineapples, coffee, sugar, cocoanuts, cotton, manioc, vanilla, grapes and other minor tropical products. There are 125,000 head of cattle. According to French statistics, the annual trade of France with New Caledonia is about \$4,500,000. The capital of the island is Noumea, with a population of 7,000. It is connected with France by steamship lines which pass through the Suez Canal and call at the southern ports of Australia before ending their voyage at

Noumea. It also has a cable connection with the Australian continent.

The natives of New Caledonia are a strong, well-built race, dark in color, with short, curly hair. When discovered they were industrious and peaceable, although they practiced cannibalism. Captain Cook



TAHITIAN YOUTH WITH TROPICAL FRUITS.

The young man is carrying plantains, raro roots and pineapples, with bread-fruit at his feet.

says: "They were courteous and friendly and not addicted to pilfering. They showed no fear of white men and never the slightest sign of hostility." Their soil being thin, they were forced to industry and careful cultivation, and raised the bread fruit, their chief food, with great success. The coast

natives are noted fishermen. The natives build high, conical houses of reed frames with close thatching of palm leaves. They are among the most peculiar dwellings that have been found in the Pacific islands.

New Caledonia lies about half way between New Zealand and New Guinea, and some 700 miles off the coast of Australia. Nearly 3,000 miles to the eastward are the other important French islands in the Pacific. There are a great number of small islands belonging to the French in this archipelago, of which Tahiti is the best known. It has an area of 412 square miles and a population of about 10,000. There is a governor for all of these smaller islands, who resides at Papeete, the chief town of Tahiti, and there is also a general council, elected by universal suffrage. The commerce of these islands annually amounts to nearly \$2,000,000. The chief exports are mother-of-pearl, copra, cotton, vanilla, sugar, coffee and oranges.

Tahiti was the first Christianized of the South Sea islands, and is now a pleasant and peaceful place in which to dwell. Its center is a magnificent mountain system, and its fertile land is in the valleys that lie between the mountains and along the sea shore. The natives dwell in separate homes instead of in villages. They are of a race resembling the Hawaiians and are athletic and of a light brown color. Their mouths are large, noses somewhat flat and teeth very white and even. They dress well in a fine bark cloth, resembling paper. The climate is warm, but healthy. All the houses are lightly and airily built, the floors covered with mats, and the roofs thatched with palm.

A large part of the trade of Tahiti and the neighboring islands is carried on by

way of the United States. The French government subsidizes a mail steamer which makes a trip once a month between San Francisco and the island capital, so that passenger and freight traffic is carried on in a regular and comfortable way. It affords one of the most attractive voyages into the tropics that any American traveler could select.



FIJI AND ITS PEOPLE

For many years in the early history of explorations in the Pacific ocean, and, indeed, until the middle of the nineteenth century, Fiji, to most readers, was a synonym of savage violence and cannibalism. Within half a century this island group has been changed from savagery to peace and order, as one of the prosperous colonies of the British empire. Fiji comprises a group of islands lying some 500 miles west and a little south of our own American island of Tutuila in the Samoan group. It is almost directly west of the Society islands, in which is the French island of Tahiti, and consequently well within the tropics.

The islands exceed 200 in number, about eighty of which are inhabited. The largest is Viti Levu, with an area of 4,250 square miles, or about the same as Jamaica. The total area of the group, however, is nearly twice that much. The capital, Suva, is on the south coast of the largest island, and is a prosperous and picturesque little city with a white population of nearly 1,000, in addition to the natives. The total population of the group is about 125,000, of whom the natives number about 100,000, the rest being divided between Europeans, laborers who have been imported from India, and other Polynesian islanders. Nearly

the entire population has adopted Christianity, and the schools and churches are well attended. The principal products are sugar, bananas, cocoanuts and cattle, although other minor tropical fruits and vegetables are produced for home consumption. The annual exports are about \$2,500,000 and the imports about half as much. The islands are administered by a governor sent

given to Great Britain. The islands are visited twice a month by trans-Pacific passenger steamers sailing between Canada and the Australian colonies, and by other local steamers which connect them with Australia, New Zealand and Samoa. Although they are no longer isolated, they have not lost their picturesque forms of native life, and, accessible as they are, form



AN AFTERNOON TEA IN THE SOUTH PACIFIC, ISLAND OF TAHITI.

from Great Britain, an executive council and a legislative council. No military forces are kept in the colony, which is the best evidence that it is peaceable and orderly.

Under their native kings the Fiji islands were always engaged in internal warfare, and finally the last native monarch, Thakombau, in 1874, yielded their independence and signed the treaty by which they were

one of the most interesting places for tourists' attention.



THE ISLAND OF GUAM

The island of Guam, the largest in the Marianne or Ladrone archipelago, was ceded by Spain to the United States in 1898 as one of the results of the Spanish-American war. It is a fertile island, thickly

wooded and well watered, about thirty-two miles long and 100 miles in circumference. The population of the island is about 9,000, of whom 6,000 live in Agana, the capital. The inhabitants are mostly immigrants, or the descendants of immigrants from the Philippines, the original race of islanders having become extinct. The recognized language has been Spanish for many years, but English is also spoken. On the island are eighteen schools, and seven-tenths of the islanders can read and write.

The island of Guam has a distinct value to the United States as a coaling station, a port of call, and a station for a trans-Pacific telegraph cable. About half way between Guam and the Hawaiian islands is Wake island, also belonging to the United States, and intended likewise as a station for the trans-Pacific cable. These three stations become very convenient as steps on the way between San Francisco and Manila.

The capture of Guam by the first military expedition sent from the United States to the Philippines in the summer of 1898 had some phases of humor about it. The people there had no knowledge that war had been declared between the United States and Spain, or even that hostilities were impending. When the ancient fort outside the harbor was bombarded they took it to be a friendly salute, and sent word out to the ships, apologetically explaining that they appreciated the courtesy, but had no powder with which to reply to the salute. Not until then did the governor know that he and his island were captured. When the ships sailed on to Manila they took with them the governor and other officials as prisoners, leaving the island affairs to be directed by the one American citizen who lived there, a young man of Spanish birth

who had once lived in Chicago long enough to become naturalized.



TASMANIA, PAST AND PRESENT

Although seldom visited by travelers from the United States, the British island colony of Tasmania has a peculiar interest in its history and in its life and industries to-day, which makes it worthy of special attention. The island lies some 200 miles south of southeastern Australia, from which it is separated by Bass Strait. It is about the size of Ireland or Ceylon, and has a population of approximately 150,000. The island was discovered by Tasman in 1642, and by him was named Van Diemen's Land, in honor of the other famous Dutch navigator who had preceded him in Pacific explorations. The island was left untouched by the European colonial powers until the beginning of the last century.

In 1804 Great Britain established a penal colony there, and from that time till 1813 it was merely a place of transportation from Great Britain and from New South Wales, of which colony it was a dependency until 1825. The first free settlers found it the prison of the worst convicts from England and Australia. The most shocking brutalities were practiced on the helpless outlaws by their guards. Years went by, during which the island obtained shocking notoriety throughout the world for the horrible offenses practiced there. Finally the free settlers increased in number to such an extent that they were influential in inducing Great Britain to terminate the policy of criminal exile. Transportation ceased in 1853, and three years later the island was created a self-governing colony and the name was changed to Tasmania in order to

escape the shadow that was associated with the older name.

Rudyard Kipling, in one of his poems, has characterized the past and the present of Tasmania in a quatrain of peculiar force and beauty:

“Man’s love first found me; man’s hate
made me hell;
For my babes’ sake I cleansed those in-
famies.

Eager for leave to live and labor well,
God flung me peace and ease.”

So the island has become to-day one of the most placid, peaceful and happy of all the colonies of Great Britain. Its area is about 26,000 square miles, and its surface, in general, is mountainous, with the highest point, “Cradle Mountain,” extending to a height of 5,069 feet. The Derwent, Esk and Huon are the most important rivers. The climate is mild and delightful, with an average summer temperature of sixty-two degrees, and in winter of forty-seven degrees. The rainfall is moderate and well distributed throughout the year, so that neither droughts nor floods trouble the people. There are extensive forests, abounding in beautiful cabinet woods and other valuable timbers. The cultivated area is approximately 550,000 acres, the chief products being wheat, oats and hops.

An important industry is found in the raising of fruit, and one great region in the southern part of the island is known as “Appleland,” so numerous are the orchards. Inasmuch as fruit here in the southern hemisphere comes into bearing at a season just opposite in the year to that when our own fruits are ripe, and the fruit-producing regions of the south are limited in area, the people of Tasmania are assured of the very highest prices for all that they raise. Dur-

ing the season for apple shipments all of the largest steamers plying between Australia and Europe call at Hobart and take immense cargoes of these delicious Tasmanian apples to the markets of London and the continent. Other important exports are wool, gold, silver, tin and hides. Fruit preserving, also, is a leading industry. The tin mines are of great value, hardly second to those of gold and silver.

Tasmania is now one of the states of the Commonwealth of Australia. Its capital is Hobart, also the largest city, with a population of 25,000, while Launceston, with a population of 17,000, is the second city. Education is compulsory. There are thirteen superior schools or colleges in the colony, one university, two technical schools, and 450 public and private elementary schools. The little colony has forty public libraries and institutions of similar character, nineteen newspapers and other periodicals, and a postal savings bank. The railways and telegraphs of the island belong to the government, and are operated in the public interest cheaply and satisfactorily. The scenery of the island is picturesque and beautiful, being pastoral in the agricultural regions and rugged among the mountains. Tasmania is the home of the tree fern, which is cultivated as a plant of great beauty in our conservatories. Whole forests of it cover the mountain sides in this southern island which looks off toward the Antarctic ocean. There are said to be no rich people and no poor ones in Tasmania, but the whole population enjoys a reasonable degree of comfort and prosperity. This is the condition considered most favorable for true happiness in any community, and Tasmanians are well contented in their little island.



By Courtesy of the Santa Fe Railway.

THE GRAND CANYON OF THE COLORADO RIVER IN ARIZONA.

BOOK IV

AMAZING WONDERS OF NATURE

GREENLAND AND ITS GLACIERS

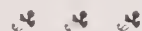
When the hymnist wrote of Greenland's icy mountains he embodied in a phrase the extremes which nature exhibits in that inhospitable land. Eric the Red, after being driven from Iceland for the murder of a brother chief, spent three years in exploring the more promising parts of Greenland, and, so grateful was he to this land of refuge, and so much brighter were the prospects here than in lava-stricken Iceland, that in contrast he gave it the name Greenland.

In 1901 there were but 309 persons of foreign parentage in Greenland, and the remainder of the inhabitants were natives fewer in number than ten thousand.

The center and the north and east are so covered with the ice accumulations of ages that no idea can be formed of the nature of the land. From the mountains there run down to the sea vast streams of ice which plow into the sea and become veritable ice-mountains, having indescribable elements of beauty. These great icebergs are cut into such forms by wind and water as to keep the imagination busy with colossal images—caverns that seem limitless, cathedral spires and gothic arches, zigzag clefts as if made by earthquakes, all with changing hues that defy the brilliant changes of the opal and the colors of the rainbow.

Usually a great river or roaring water pours from underneath the sea of ice. Sometimes the icy lake spreads out in a valley several miles across, in which the ice is a thousand feet deep, and then it moves on through a gorge cutting its way with irresistible power.

Denmark has never received much value from its possession of Greenland, and it is doubtful if this great island will ever contribute much more than it does now to the human race.



ICELAND AND ITS GEYSERS

Iceland is indubitably one of the most interesting spots on the face of the globe. Though as large as Ireland, it is in the interior a frightful desert; and it is only populated on its southwestern side by about 75,000 souls. Surrounded by stormy seas, which are generally covered with ice, this island,—with its tall, bare mountains, crowned with eternal snows and ice; its numerous precipices; its enormous lava fields, and the ever-present traces of frightful earthquakes and desolating eruptions; without a tree, and, with the exception of the seaboard valleys, without vegetation,—produces a startling effect on the traveler.

The geyser district lies at the foot of a steep but not very lofty hill, in a plain about ten miles in width, doubtless the bed

of an old fiord, which runs down to the sea, and resembles an outspread green carpet of marshy pasturage. It is watered by the Tugn flyot and several smaller streams, which fall into the Hvita at the end of the valley. In the northeast the plain is bordered by the Blafell, a lofty extinct volcano, whose summit is partially veiled by clouds, and whose steep sides, denuded of all vegetation, display caverns and ravines filled with masses of snow. Round the plain are also other masses of jagged mountains, which, in the interior of the island, are piled up in gigantic forms; while Hecla, covered with its mantle of snow, proudly looks down upon the whole scene. The elevation of the springs above Reykjavik is, according to Bunsen's calculations, about

360 feet. The principal springs are situated here close together, the two extremes being hardly 600 feet apart.

The most noted of Iceland's geyser springs is that of Strokkur. Preceding each eruption there is the hollow sound of some vast drum struck by a thunderbolt, then a mighty pillar of steam and spray rises with incredible force to the clouds. Following this a solid body of water rises to the height of 800 or a thousand feet. This eruption rarely occupies more than six minutes.

The population of Iceland is quite stationary at 75,000, and their exports are chiefly sheep, wool, dried fish, oil, eider down, moss and seal skins. The only wild animal is the arctic fox.



"OLD FAITHFUL," A GIANT GEYSER OF YELLOWSTONE NATIONAL PARK.

THE GREAT LAVA DESERT OF ICELAND

In the central region of North Iceland is the most extensive solid lava desert in the world. On clear days the inhabitants living at the edge of the rocky tract of barrenness can see in the great distance thin streams of smoke arising as if from the chimney-tops of a city. This has established a firm conviction in the minds of the natives that a strange race of beings inhabit fertile valleys that lie between the volcanic peaks. The country abounds in stories of adventures with those imaginary people.

In 1876 the Danish government sent a scientific exploring party over the wastes and the myths were exploded as far as the more intelligent class of persons was concerned. However, the lava bubbles and volcanic outbursts have left such curious shapes and figures all over the dreary wastes that, if the imagination is allowed the least freedom, almost anything from the most hideous prehistoric creatures to well-arranged modern cities can be conjured up through the naked eye. Though a good field glass may dispel the given illusion, at the end of the range of the glass there will be another fully as startling.



THE GULF STREAM

Among the wonders of physical geography few are more interesting in their relation to this country than what is known as the Gulf Stream. This is an oceanic current of great extent, which takes its rise in the Gulf of Mexico, whence it derives its name. The peculiar formation and position of this gulf render it a receptacle for the waters of the Atlantic, which sweep

across the northeastern coast of South America; and, on arriving in the Gulf, they become warmed to a much higher temperature than is anywhere found in the surrounding ocean. The summer temperature of the waters in the Gulf is about eighty-eight degrees, while in the open Atlantic, in the same latitude, it is only seventy-eight degrees.

Thus warmed, the waters pass out of the Gulf northward, in a deep and strong current, between the coast of Florida on the one side and the islands of Cuba and the Bahamas on the other. The stream progresses here with a velocity of five miles an hour. It rolls like a mighty river along the shore of North America, widening as it flows, until it nears the banks of Newfoundland, where it is turned aside, partly by the formation of the coast, which here projects boldly out, and partly by the encounter with strong and adverse currents from the North Atlantic. At the point where it is turned aside it stretches almost across the Atlantic; the current itself, according to some, being about two hundred miles in width, and the warm waters of the stream extending in all more than twice that distance. In the latter part of its course it leaves behind it that remarkable drift of sea-weed known as the Sargasso Sea.

Crossing the Atlantic eastward, towards the islands of the Azores, the main stream gradually becomes lost, and its current spent; but a portion of it continues northward towards the British Islands. Long after the current itself is lost the neighboring seas continue very sensibly affected by the warm waters which it has brought down.

It is important to bear in mind the distinction between the actual current of the

Gulf Stream and the heated waters which are brought down by its agency. The range of the latter extends some hundreds of miles after what is properly termed the Gulf current has ceased.



THE MAELSTROM

The Maelstrom is a whirlpool off the coast of Norway, between the islands of Loffoden and Moskoe; and because of its proximity to the latter is sometimes called the Moskoestrom. Many stories have been written about it which border on the confines of the marvelous rather than of the truth. Poets have been busy with the fact of its existence, and ancient legends have told with wonderful exactness how heroes have dived into the vortex in order to show their zeal for their lady loves, and how virtue and courage have come unharmed out of the great depths, while wickedness and vice have so weighted men that they have been overwhelmed in the whirlpool. Old-world thought led to the belief that at the spot where the Maelstrom was there was a great hole in the earth, through which the water poured, and that those things or men which were engulfed in the pool were either passed through the earth to its other side or were returned broken and drowned to the place whence they came by a return coil in the mysterious water spiral. Water jotuns, or water giants, were of course supposed to preside over the whirlpool, and to arrange according to the dictates of their own fancy who should be saved and who destroyed. One hero whom they permitted to re-visit the upper world was speechless ever after, unable, by sign or word, to give an account of the marvelous things he had seen. Many

a ship was sucked down into the watery grave, many a fair cargo lost, and yet the water-demon was not satisfied; no amount of sacrifices seemed to propitiate the hungry ocean gnomes.

Modern science, with its secret-searching light, has scared the water-demon from his lair, and has given an explanation of the causes of the whirlpool, quite incompatible with the existence of such a contrivance as the Maelstrom was represented to be. When the configuration of the land between Droutheim and the North Cape is seen it will not surprise any one that the rush of the tide, cooped up as it is in its passage through the Loffoden Islands, should result in a wash of the whirlpool kind. The strong tide flowing down from the northern sea is caught in a rocky angle, which causes a kink in the stream, twisting it round with violence enough to cause the Maelstrom, the most dangerous whirlpool in the world. The whirlpool is thus described by an American writer: "I had occasion, some years since, to navigate a ship from the North Cape to Droutheim, nearly all the way between the islands, or rocks, and the main. On inquiring of my Norwegian pilot about the practicability of running near the whirlpool, he told me that with a good breeze it could be approached near enough for examination without danger, and I at once determined to satisfy myself. We began to near it about 10 a. m. in the month of September, with a fine leading wind N. W. Two good seamen were placed at the helm, the mate on the quarterdeck, all hands at their stations for working the ship, and the pilot standing on the bowsprit between the night-heads. I went on the main topsail-yard with a good glass. I had been seated but a few minutes when my ship entered the dish of the whirl-

pool. The velocity of the water altered her course three points towards the center, although she was going eight knots through the water. This alarmed me extremely for a moment. I thought that destruction was inevitable. The vessel, however, answered her helm sweetly, and we ran along the edge, the waves foaming round us in every form while she was dancing gaily over them. The sensations I experienced are difficult to describe. Imagine an immense circle running round, of a diameter of a mile and a half, the velocity increasing as it approximated towards the center, and gradually changing its dark blue color to white,—foaming, tumbling, rushing to its vortex; very much coneave, as much so as the water in a funnel when half run out; the noise too, hissing, roaring, dashing,—all pressing on the mind at once, presented the most awful, grand, solemn sight I ever experienced. We were near it about eighteen minutes, and in sight of it two hours.”



THE SPECTRE OF THE BROCKEN

The beautiful, deceptive phenomenon known as the mirage is of three distinct kinds. First, there is that form of it where some distant object, below the line of the horizon, and consequently out of the range of vision, seems to be lifted up into mid-air, and to hang suspended there,—sometimes in its natural position, sometimes upside down, and sometimes both ways at once; the image in this latter case being doubled, like a ship and its reflection in the water. Secondly, there is that form of it where some object high up in the air, such as a cloud or a village on a hill, seems to be brought down and to lie floating in a vast

lake stretching miles away at the spectator's feet. Thirdly, there is that less frequent form of it, where the setting sun appears to fling huge shadows of terrestrial objects far out into space.

The mirage, in which the object is brought down instead of being elevated, is most frequently seen in the arid deserts of Lower Egypt, where it often proves cruelly deceptive to the thirsty traveler. Dotted about the waste are elevations, on which the natives have built their villages, in order that they may be safe from the flood during the periodical inundations of the Nile. In the heat of the day the mirage brings down an image of the sky upon the level, some few miles in front of the caravan, and produces the effect of a broad expanse of water, in which each village, brought down also, appears as an islet. Lured on by the refreshing prospect, man and beast push hopefully forward, often miles out of their track, to find the waters and islands constantly receding from their view, until the evening comes, and they vanish altogether. So complete is the illusion that not only experienced and scientific travelers, but even the Arabs themselves, are often deceived by it.

The third kind of mirage is seen only from the top of the Brocken, the highest summit of the Harz Mountain range in Hungary. It is there known as the *Brockengespenst*, or “Spectre of the Brocken;” and very spectre-like it looks in the red evening sun. You no sooner step out upon the plateau on the top of the hill than your shadow, grim and gigantic, is apparently flung right out against the eastern sky, where, with all visible space for a playground, it flits swiftly from place to place, following your every movement. It is only

in the evening just before sunset that the phenomenon is visible, so that the shadow is doubly exaggerated, first by the distance and level of the sun and then by the distance of the surface upon which it is projected.

Each of these different kinds of mirage has its own separate cause, though they all depend for their existence upon a special state of the atmosphere. Before the phenomenon is possible the air must be divided into strata of different degrees of density. That done, the mirage follows, sometimes by refraction, sometimes by reflection, sometimes by the projection of shadows.



FAMOUS FOUNTAINS OF PALESTINE

Nearly every pool or spring about Jerusalem is of sacred historical note in some form of legend or story. The best known of

these is the Pool of Bethesda. It lay close by the wall of the city at the sheep's gate and the word meant "house of mercy or place of flowing water." Porches and colonnades were in bible times built about it so that the people could protect themselves from the sun.

It was believed by the people that at frequent intervals an angel came down and troubled the waters, after which they had healing qualities. Here is where Christ told the sick man to take up his bed and walk.

This pool is now called Birkeh Israel and the gate near by is called St. Stephen. Little regard is paid to it by the natives and it is in ruins.

Ain Selwau is the name now given to the fountain by which the Lord stood when He said, "If any man thirst, let him come to me and drink." It is mentioned by the prophet as "the waters of Shiloah that go



AMERICAN TOURIST PARTY IN PALESTINE.

softly." It was to this pool that Christ sent the blind man to be healed.

A church was built over it in the middle ages, but it was destroyed by the Moham-medans. On its banks stands a mulberry tree said to mark the spot where the prophet Isaiah was slain by Manasseh.

In a shallow vale by the Jaffa gate beyond the olive groves near Jerusalem is Birkeh el Mamilla, which was known as the fountain of Gihon to which Solomon rode on King David's mule, when Zadok the priest took the horn of oil out of the tabernacle, and annointed Solomon, as the people cried, "God save King Solomon." Near by this ruined fountain is the potter's field bought with the blood money of Judas.

Over toward Jericho is the fountain of Elias, much famed for its healing power in bible times; further on in the fertile valley of Kedron, on the boundary line between Judah and Benjamin, is the most famous pool of modern Palestine. Its Arab name means Fountain of the Mother of Steps. The Jews call it En Rogel; that is, to tread, from the custom of treading linen in the water. This pool is 360 feet in length and 130 feet in width. Here is where Jonathan remained when he sent the little maid to bear a message to David, who had fled from the power of his son Absalom.

It was from the Roman tower Antonio, near by, that St. Paul made his memorable speech to the Jews. This tower is still standing, though half in ruins. Here St. James was slain.

The Christians have named this the Fountain of the Virgin, for here the mother of Jesus came with other Jewish girls to cleanse the linen. To this day the beautiful stream of pure water flowing from this spring is used for the same purpose, and

troops of large-eyed oriental girls are seen working about the pool and stream just as has been done here by the girls of Jerusalem for two or three thousand years.



SAGHALIEN, A PARADOX OF CLIMATE

Saghalien belongs to Russia, and is separated from the mainland of Eastern Asia by the Gulf of Tartary.

The island is bathed by two cold ocean currents, and in winter nothing protects it against the icy northwest winds coming from Siberia. At the sea level the snow falls continually, and stays on the ground till the end of May, and the seashore is very cold. Further inland, however, especially as we go higher up, the climate is modified—just the opposite to what is observed elsewhere. It has often been observed in Siberia and in Central Europe that in winter the cold is greater in the plains and the valleys, and that the highlands have a sensibly milder temperature; it is as if the denser cold air accumulated in the lowlands. This fact is very often observed in our climate; there are several very good examples of it; all the trees and shrubs of a valley have been known to be killed by frost, while above a certain level, very clearly marked out, on the hill or the mountain, the vegetation has not suffered at all. The cold air often flows from the summits toward their bases. This is what takes place at Saghalien. The cold air accumulates in the low regions of the island and on the coast; the higher regions have a more elevated temperature. So it happens that the lower parts have an arctic vegetation, while the intermediate altitudes have the vegetation

of a temperate zone, sometimes almost sub-tropical. The birch, the ash, the pine, the fir abound in the low regions and form often impenetrable forests, but toward the center of the island appear bamboos, hydrangeas, azalias and other plants that one is greatly surprised to meet, and whose presence can be explained only by the altogether abnormal climatic conditions of the island.



THE ARABIAN DESERT

Arabia meets Palestine on the north, and from these lands have flowed the influence of Moslem and Christian well-nigh covering the world. As Jerusalem is the sacred city of many millions of Christians, so is Mecca the sacred city of many millions of Mohammedans. Not only have two of the great religions come from this small territory of habitable land, but it was once the garden from which came the seed of civilization.

Poets have sung of these lands, romancers have written of them and pious priests have glorified them till in our imagination they are the realms of pearl and amber, redolent with the fragrance of aromatics, spices, frankincense and myrrh.

The poets have been the geographers, and on epic authority we are assured that it is a paradisiac region laden with the inspiration of divine perfumes.

“To them who sail
Beyond the Cape of Hope, and now are
past
Mosambic, off at sea northeast winds blow
Sabeian odors from the spicy shores
Of Araby the blest; and many a league,
Cheered with the grateful smell, old Ocean
smiles.”

Here in truth is the dream-land of the world, replete with scenes made awesome through sacred song and story.

Strange remnants of Christian and Moslem occupation still remain almost unchanged.

About nine days of camel travel into the desert from Suez brings the traveler to one of these remnants, a spot of impressive loneliness and desolate grandeur at the foot of Sinai. It is the convent of St. Catherine, made like the stronghold of a castle with battlements on which are mounted ancient guns. The approach of strangers is guarded with all the ceremony of medieval times, when the least relaxation of caution or vigilance might mean destruction. Those approaching come up through the groves of cypress trees to the massive stone walls, where there is nothing but silence and no moving creature is to be seen. Back of the convent the perpendicular sides of the rocky cliffs rise to the height of a thousand feet and add to the solemnity of the scene.

After repeated calls a port hole is opened about 30 feet above the heads of the visitors, the face of a monk appears, and, after surveying the visitors stolidly for a few minutes, he lowers a rope from a windlass.

The letter of introduction from the convent at Cairo, which is indispensable, is fastened to the cord and it is drawn up.

This much of the customs has yielded to the improvement of government and the safety of modern times; they no longer draw the visitors up by the windlass, but after reading the letter a gate is at last opened and the visitor allowed to enter the court. Moses being a holy man alike to Christians and Mohammedans, there are both chapels and mosques about the place where the commandments were given. How-

ever, with sectarian perversity the Christian has decided on one mount as the scene of the handing down of the law to Moses and the Mohammedans another. Mount Horeb is the one generally agreed upon by Christendom.



THE GREAT TREES OF CALIFORNIA

All the world has heard of the big trees of California, and those astonishing groves of forest giants which have attracted strangers from far and near to view their wonders. California is a state of great things, with its coast-line as long as that which stretches from Massachusetts to Georgia, its mountains which are surpassed on this continent only by a few Alaskan peaks, its gold mines, its orange groves, and its smiling valleys devoted to farming, all rivals in magnitude as the sources of greatest wealth, and its Yosemite Valley with the great cataract that plunges 1,500 feet sheer in one of its three downward leaps and its colossal

domes, spires and arches of pure granite, contrasted with soft tones of green forest and silver lake. Of all these wonders the great trees themselves of the Mariposa and the Calaveras groves are,

perhaps, the most conspicuous and the most widely known objects of curiosity. They are the oldest living



TWO GIANTS IN COMPARISON.

Masonic Temple, Chicago, 302 feet in height and Big Tree, 400 feet high. This ingenious picture, in which the artist shows one of the big trees apparently growing in a city street, depicts how nature's work overtops that of man.

things in the world. The best scientific estimates place the age of the oldest at about 5,000 years, and thus make them survivors of the Miocene period. It taxes the imagination to conceive the age that this means and the natural history of our globe which these grizzly giants have witnessed. With the danger of their complete extinction threatened as it seems to be, they become doubly interesting to us all.

Students of the groves declare that these big trees of California are not akin to any other trees now growing, except some of their own neighbors. Only by comparison with certain fossil remains of cone-bearing trees was the proper relationship found, and the kings of the forest were discovered to be species of the genus *Sequoia*. In deference, therefore, to the name of our greatest citizen these greatest of trees were named *Sequoia Washingtoniana*. Popularly speaking, however, the name *Sequoia Gigantea* has come to be accepted as the characterization of these monsters.

It was just about the time of the rush of the forty-niners to California in the days of gold discoveries that these trees were found. According to the scientists, the Sequoias covered great areas of America and Europe, far back in the mysterious, moist days of the Miocene period when all vegetation took strange, gigantic forms. When the age of ice came and our continents were swept by the glaciers that have left their tracks in every direction some of these ancient forms of vegetable life were exterminated, some were left as fossils and a few have come down to us in visible forms upon the surface of the earth as living things.

These two groves of big trees may be considered as small islands, upon which they were left in safety after the great up-

heavals of nature that passed around them. Here they have survived through all intervening thousands of years, so that today they have the distinction of being virtually the only survivors of a geologic age that is past. In addition to the two most famous groves, the Mariposa and the Calaveras, there are some other tracts in California which contain groves of Sequoias, although not the largest ones. Altogether there are 200,000 or 300,000 of the species, but of those remarkable for their great size not more than 500.

A common height for the pines, firs and cedars, which grow in the same forests, themselves noteworthy specimens of their own variety, is from 175 to 200 feet, but these are overtopped at least a full hundred feet by the big Sequoias that grow beside them. There are trees in the Mariposa groves which are nearly thirty feet through, and a great many between ten and twenty feet. Inasmuch as the largest trees are still standing, it is impossible to count their rings and measure their age exactly. But one tree that was cut down was found to be 2,200 years old, and another that had fallen to the force of the winds showed an age of 4,000 years. It is a fair estimate, therefore, that the larger ones still are at least 5,000 years old, and this agrees with the calculations as to the period whence they date.

Mr. John Muir, who has studied the trees and mountains and glaciers of the west with affectionate energy, calls attention to the vitality and vigor of these trees, and the fortunate way in which nature has protected them. The bark is thick and fibrous, and all but fireproof, so that forest fires have not been able to destroy the trees. The wood, too, does not decay, and fungus does

not, therefore, thrive upon it. Even the trees that have fallen have lain sound for centuries.

The threat of extinction of the great trees comes from two causes. They are not inclined to rear new trees from seedlings, to reproduce their own groves, and the fine old trees themselves in many instances have been attacked by the lumbermen holding the land upon which they grow. The Mariposa grove is now owned and protected by the State of California, and there is an effort under way to purchase the Calaveras grove as a government park. But by far the greater number of the big trees are on land owned by the lumber companies, and many of them are at work on the Sequoia timber. The people of California are becoming aroused to the great value of these forest giants, as sources of interest for the tourists who flock to their state, and it is to be hoped that the vandalism which is threatening the existence of some of the finest specimens will be put an end to by the influence of public opinion and the purchase of the property for permanent preservation. The wood is not particularly valuable as timber, and it seems a manifest truth that the big trees, considered entirely as an investment for the state, would yield more as living curiosities than as lumber piles.



HOW GLACIERS AND ICEBERGS ARE MADE

Great mountains of snow and ice, which float down into the North Atlantic Ocean from the Arctic regions to threaten the safety of vessels crossing from America to Europe, are among the most peculiar and

interesting of the works of nature. The land of their birthplace in the far north is not reached by many travelers, except the Arctic explorers themselves, but instead of the traveler coming to the iceberg the iceberg comes to the traveler, thus reversing the famous experience of Mahomet and the mountain.

The coasts of Greenland are the birthplace of the greatest icebergs that come into the Atlantic Ocean. They are produced from the glaciers which fill the valleys of this frozen land.

The story of the glaciers, from which icebergs are but offshoots, is an interesting one. A great weight of snow pressing downwards through 'crooked mountain valleys' is squeezed between the rocky walls and gradually converted into ice. The great body of the glacier, which is neither snow nor ice, but both, creeps along and molds itself to its bed. But in changing its shape and slope its surface is broken by deep crevasses, which begin as simple cracks. These crevasses are caused by the tension or pull of the lower mass of ice upon the upper, and consequently they generally occur transversely or obliquely up-stream. Dirt accumulates in the crack until the whole mass closes by being pushed into a new position. Elevations in the bed of the glacier thus leave a permanent record in the ice which breaks above them. This record is carried on the center of the stream, which moves faster than the margin, and consequently these dirt-lines, which mark the former crevasses, gradually become bow-shaped, until they almost touch each other at the margin. Viewed from above, the effect is very striking, and these dirt-bands, as one may call them, appear sometimes like the graining on a slab of oak. When the

crevasse fills with snow instead of dirt the bands are white instead of grey. The newly-fallen snow on the mountain tops is gradually made firm by pressure. Slowly, almost imperceptibly, it begins to glide down the slopes; air, before imprisoned, escapes, and the snow hardens. After a time the mass reaches a steep slope, confined in a valley, and then pressed down from behind and from the sides, it changes into clear, blue ice, streaked with little veins where the air has not been expelled. And so a little tongue of ice begins creeping down the valley until it swells into a great river, terminating in a vertical wall hundreds of feet in height. As the long, sinuous band of ice continually creeps down from the mountains the topmost portion moves faster than the ice below, and finally a piece breaks off, either on the mountain side or in the sea, if the flow has traveled so far. In this way the smaller icebergs are formed.

"Calving" of icebergs, as the breaking off of blocks from the parent glacier is called, is produced by the action of the tide. Upward and downward pressure, exerted by water at the rise and fall of the tide, on submerged portions of the glacier front, forces off a strip of ice, which floats away as a berg.

The Humboldt Glacier, sixty miles in length, is the most celebrated in Greenland, and has a perpendicular face of 300 feet. The glacier was discovered by Dr. E. K. Kane, U. S. N., in 1853. We take the liberty here to quote from Dr. Kane's book, "Arctic Explorations," his striking description of it. "My recollections of this glacier are very distinct. The day was beautifully clear on which I first saw it, and I have a number of sketches made as we drove along the view of its magnificent face. They dis-

appoint me, giving too much white surface and badly fading distances, the grandeur of the few bold and simple lines of nature being almost entirely lost. I will not attempt to do better by florid description; men only rhapsodize about Niagara, and the Ocean. My notes speak simply of the 'long, ever-shining line of cliff diminished to a well-pointed wedge in the perspective,' and again of 'the face of glistening ice, sweeping in a long curve from the low interior'; the facets in front of the cliff rose in solid glassy wall three hundred feet above water-level, with an unknown, unfathomable depth below it, and its curved face, sixty miles in length, from Cape Agassiz to Cape Forbes, vanished into unknown space at not more than a single day's railroad travel from the Pole. The interior with which it communicated, and from which it issued, was an unsurveyed mer de glace, an ice-ocean to the eye, of boundless dimensions. It was in full sight—the mighty crystal bridge which connects the two continents of America and Greenland. I say continents, for Greenland, however insulated it may ultimately prove to be, is in mass strictly continental. Its least possible axis, measured from Cape Farewell to the line of this glacier, in the neighborhood of the 80th parallel, gives a length of more than twelve hundred miles, not materially less than that of Australia from its northern to its southern cape. Imagine, now, the center of such a continent, occupied through nearly its whole extent by a deep, unbroken sea of ice, that gathers perennial increase from the water-shed of vast snow-covered mountains and all the precipitations of that atmosphere upon its own surface. Imagine this, moving onward, like a great glacial river, seeking outlets at every fiord and valley, rolling icy cataracts

into the Atlantic and Greenland seas; and having at last reached the northern limit of the land that has borne it up, pouring out a mighty frozen torrent into unknown Arctic space. It is thus, and only thus, that we must form a just conception of a phenomenon like this great glacier. I had looked, in my own mind, for such an appearance, should I ever be fortunate enough to reach the northern coast of Greenland. But now that it was before me, I could hardly realize it. I had recognized, in my quiet library at home, the beautiful analogies which Forbes and Stndor have developed between the glacier and the river. But I could not comprehend at first this complete substitution of ice for water. It was slowly that the conviction dawned on me that I was looking upon the counterpart of the great river systems of Arctic Asia and America. Yet here were no water feeders from the south. Every particle of moisture had its origin within the Polar circle, and had been converted into ice. Here was a plastic moving, semi-solid mass, obliterating life, swallowing rocks and islands, and plowing its way with irresistible march through the crust of an investing sea."

The glaciers from which the bergs break off crop out all along the Greenland coast. On the other side of America, on the Alaskan coast, are other great glaciers, one of them, the Muir Glacier, being frequently visited by summer tourists in excursion parties up the Alaskan coast. But these Alaskan glaciers do not send their iceberg children far down into the track of vessels in the Pacific Ocean, as do those of Greenland into the Atlantic.

Up to the middle of August travelers crossing the North Atlantic are very likely to see the fragments of these great moun-

tains of ice which have floated down from Baffin Bay and have not yet entirely melted under the influence of the warm weather. During some seasons these icebergs form a source of considerable danger to ships, and more than one collision between a great Atlantic liner and these navigators from the Arctic have been reported in the list of marine disasters in recent years. Frequently the icebergs bring with them a local fog which screens them for miles around like a low hanging cloud. This results from the contact between the warm, moist air rising from the ocean, and the cold rays radiated from the great body of ice. When a ship enters a fog in the North Atlantic, at such a season, the navigator watches for icebergs quite as carefully as for other vessels. He has two sources of warning when danger threatens. From the iceberg itself, the sound of the steamer's whistle is echoed back to him so that he may judge the direction of the berg and may estimate its distance by the time required for the return of the echo. As he draws nearer, steaming slowly through the fog, a delicate thermometer prepared for the purpose on the bridge of the vessel, responds to the cold given off from the frozen mass, and the mercury falls rapidly. It is at such times that the skill and caution of an able navigator are displayed.

Let us trace the history of one of these great icebergs from the time it has broken loose from the parent glacier to float away into the waters of Baffin Bay, Davis Strait and Smith Sound. Seven-eighths of the weight of the iceberg is under water and one-eighth of it above. When we see an iceberg which extends a hundred feet, or, perhaps, much more above the water, we know that it is practically seven times as

great below the surface. This suggests the enormous mass of ice and indicates the danger which it threatens to a colliding vessel. The current acting upon this mass under water causes irregular pieces to be detached. Thus the balance of the berg is changed, and it turns over sufficiently to restore its equilibrium, with the heaviest part once more hanging downward in water. It thus floats, moving with the current generally southward, the sun's rays, wind and frost changing the exposed surface and the outline of the berg itself. When the warmer currents of water are reached in lower latitudes melting takes place, till the bergs finally disappear altogether in the Gulf Stream.

It is this melting of icebergs as they move southward into the warm water that has built up from the floor of the ocean that remarkable tract known as the Grand Banks of Newfoundland. The glaciers of Greenland carry with them as they move toward the sea great quantities of stone and sand, gathered as debris from the mountain valleys where they were formed. The icebergs breaking away from the glaciers and floating southward into the Atlantic carry with them these same fragments, and as they melt ultimately deposit the debris upon the floor of the ocean. This process continuing through centuries upon centuries, they have built in the Atlantic a great plateau, surrounded by deep water, rising within a few hundred feet of the level of the sea. This peculiarly submerged plateau lying to the southeast of Newfoundland covers an area of some 200 by 400 miles. On these Grand Banks are the favorite fishing grounds of the fleets that sail from Massachusetts and Newfoundland every year for cod and mackerel. The greater Atlantic

liners usually pass to the south of the Grand Banks in order to avoid the fogs, the icebergs and the fishing vessels which obstruct the more northern route. But in early summer the tourist on a vessel sailing from a Canadian port and crossing the Grand Banks can hardly fail to have the pleasure of seeing one or more of these great travelers from the Arctic, as well as numbers of the fishing schooners themselves, working in these shallower waters.

We observe that the ice of the bergs looks like great masses of chalk or loaf sugar, varnished, if you please, or glistening like powdered glass. At times it is pure white, at others it looks greenish, and we note that this greenish tone is caused by the reflection of light upon masses of ice under water, thrown back upon the exposed surface. The shadow side, away from the sunlight, is a beautiful blue, traceable to the reflection from the sky. We also see icebergs of a beautiful blue color, and these are built up of ice formed from fresh water, the water melting upon the surface of the glaciers, due to evaporation, rain and melting snow, being different from ice or frozen water, containing salt, in that being much thinner or porous, it absorbs light. Charming cobalt blue bands are sometimes seen running through bergs, and these are the streams of fresh water frozen before the berg was formed, invaluable as the fresh water supply of the Arctic ships.

Let us look at that great glacier with irregular front, as high as a six-story house, with a length of a mile and a half. We are steaming about four miles away, and the day is beautifully clear, with bright sunshine. The air is crisp, like one of our winter days, the water calm as a mill pond, and a great silence reigns. Floating pieces

of ice called floebergs and icepans, with a seal lying asleep upon them, float by. Arctic birds, the puffin, eider duck, mormons and kittiwakes, fly past; a charming tranquillity rests over all and we feel at peace with all the world. A great boom is heard, like the report of a big gun, echoed and re-echoed till it dies away.

We look toward the glacier. A mass of the ice, as large as eight city houses, is slowly detaching and sliding away, sinking, sinking very slowly, pushing in front of it a high green wave of water, which approaches like a wall. As we look the mass turns over, and as a portion rises the water is thrown off in a great cataract. The mass sinks out of sight, now it rises again. It rocks from side to side, sinks again, nearly out of sight; rises again, turns

a little, and thus for twenty minutes it keeps moving. The waves have reached our ship, and we rock, heave and dip under their influence. At last the berg has settled quietly, and is floating with the tide. A beautiful blue cave is visible, a great turret at one end, a sloping mass rising toward the opposite. A great concave channel slanting along its base shows the former action of the water line. This berg will float southward, gradually melting, changing its form, becoming smaller, and finally mingling with the wa-

ters of the Atlantic. Thus an iceberg is born and dies.

* * *

TRINIDAD AND ITS BITUMINOUS LAKE

Columbus discovered Trinidad in 1498,



THE GREAT ASPHALT LAKE OF TRINIDAD.

and gave it that name because of the three mast-like mountains on it which appeared to rise directly out of the sea. With the island of Tobago it forms the British crown colony of Trinidad. Trinidad has 1,754 square miles and its chief town has the singular name Port of Spain. At the nearest point it is only 9 miles across the Gulf of Paria to the mainland of Venezuela.

Near the village of La Brea is a strange fresh-water lake of about 300 acres, the surface of which is covered with pitch. The asphalt bubbles up in the center and hard-

ens upon the surface, from which it is taken for export. The deepest soundings have never been able to reach any bottom, although the surface of the lake is only 80 feet above sea level.

On the shore nearest the lake a great deal of bitumen is thrown up by the sea. The pitch on the side of the lake next to the sea is never hard, but on the other side it hardens to a great depth and is rent in fissures twenty or thirty feet across. This part of the lake, from which about 100,000 tons are annually exported, consists of 110 acres.

It is estimated that this lake alone would pave all the streets of the world, and that the supply is inexhaustible for all human purposes.



DEATH VALLEY

Away out in California, near the southern extremity of Nevada, far from any railway and lying in the heart of a barren, desert country, is that fatal depression marked on all maps by the name which it has long justified, "Death Valley." The gloomy history of the place for many a year has deterred even the most curious of visitors to the neighborhood from attempting to traverse its barren expanse. And yet Death Valley is being explored in all its parts. Tell that to a Californian and he will laugh at you. "It is impossible," he will jeer. "The fools who try to ask that mouth of hell for its mysteries will die. Death Valley cannot be explored."

But Death Valley is being explored. And the explorers are not plainsmen inured to hardship, but college professors from the East. They come from Boston and Chicago, and are botanists, biologists, and mineralogists. Tell that to a Californian,

and he will say that you are insane or they are.

Death Valley comes by its name honestly. It is the most hideous and most fatal spot known to man. No spot in Asia or Africa is so destructive to life. No depression on earth is so far beneath sea level. No other place on earth is so hot. No other desert is dryer.

At one point in the Valley, where the depression is 200 feet beneath the level of the sea, and the width across seven miles, a mountain rises on one side to the height of two miles, and on the other side is another mountain 8,000 feet high. The sides of the two mountains are almost sheer. Into this pit, with its bottom of borax dirt, waterless, the sun beats directly down in summer, and not a breath of wind is ever felt on its floor.

That seven-mile stretch between Funeral Peak and Telescope Peak is the cruelest and most horrible spot on the face of the whole earth. No man could be alive in it in summer for half an hour. The temperature has never been taken. In other parts of Death Valley 137 degrees has been observed and recorded, but no record has ever been made of the summer heat of that terrible seven-mile stretch.

Death Valley is a land of paradoxes. In the summer it kills off the healthy who so much as approach it. In the fall it heals and restores the sick who invade it.

John R. Spears wrote of it: "It is a place where rain-storms are well nigh unknown, and yet one where the effects of cloudbursts are almost unparalleled. It is the hottest place on earth, and yet ice often forms there. It is a place where the air becomes so arid that men have died through lack of moisture when abundant water was

at hand, and yet the stopping place of hundreds of duck, geese, and other fowl. It is a region where the beds of lakes are found on the pointed peaks of the mountains. It is a region where a mountain system of the most gorgeous colored rocks is known as the Funeral Range. It is a rent in the earth, the bottom of which, in spite of the washings, probably is deeper below the level of the sea than that of any other valley in the world."

Death Valley has mines and marshes and borax beds. For this reason the exploring party is invading a part of the valley hitherto let alone, for the Los Angeles, San Pedro and Salt Lake Railway is running a new line across the desert country, north of the valley. The road will make somebody rich who owns part of Death Valley and keeps away from it. And it will kill lots of men who own nothing of it and go into it.

The bottom of the valley is made of great acres of saline deposits, beds of borax and salt, which, under a strong sunshine, present a ghastly appearance with their glistening whiteness. The bedrocks are shale and schist left from the Jura-Triassic period, but a most extensive volcanic eruption has so scattered and demoralized the various formations, that widely different deposits are often found within a few feet of one another. There are dozens of craters of extinct volcanoes in the valley, and with their blackened ruins and coating of dark cinders, acres of area, the general whiteness of the valley bottoms stands out all the more lonely and ghastly.

Death Valley lies in Inyo County, many miles from the nearest railroad, 350 miles from the Pacific Ocean, and close beside the Nevada-California state line. It is a part of the Mojave and Colorado deserts,

and is the quintessence of all that is melancholy, grim, and withered in desert characteristics. The valley proper is about one hundred miles long and fifty miles wide.

The mirages of Death Valley are the most remarkable in the world. Every day in any season one sees among the parched hills and scaled mountain sides, phantasmic pictures, miles in area, of foaming mountain streams, sylvan shades, alfalfa fields, and browsing cattle-scenes, reflected from the sides and tops of the Sierras. Occasionally scenes from the Pacific Ocean may be reflected in the mirages, and sailing ships and tossing waves may be seen amid the shimmering, desolate sand hills and alkali cañons of Death Valley. The Indians call the mirages the Big Spirit's pictures. Sometimes in the hottest weather the mirage will remain floating wonderfully distinct in the valley for a day at a time, but generally it lasts only a few minutes. Then the phantasma vanishes in a twinkling, to be soon succeeded by another, until as many as seven different mirages have been seen there in one day.

Sand storms are a serious thing on the Colorado and Mojave deserts, but nowhere do they approach the deadliness of the sand storm in Death Valley. The simoons of the Arabian Deserts are well known in literature, but the explorers of Death Valley say the simoons are mere babes by the side of a howling gale of hot sand in this place. The hot air rising from the cañons and the bottom of the valley encounters the cold atmospheric currents from the Sierras and Rockies, and the rushing of the cooler air into the valley instantly creates a storm undreamed of in any other part of the world. For hours at a time the sand storm rages, occasionally for a day and a night.

Nothing alive can brave the hurricane. The man who will keep close within a tent, with his head wrapped in a blanket, will survive, but he will suffer with the heat almost as severely as if in an oven, and for days thereafter with pain from smarting nostrils and inflamed ears and eyes. Old-time plainsmen who know about all the hardships a man's anatomy can experience, are a unit in saying that the desert sand storm, more particularly a Death Valley sand storm, is the most trying physical ordeal. The mountains which bulwark Death Valley show the terrific erosion of their flinty faces by successions of these tempests. Here and there are starved grease-root plants, like stunted, starved trees that have been half-buried in the sand during these storms. Many a man who has been a desert teamster or a mining prospector has suffered chronic inflammation of the eyes by reason of having experienced one of these whirlwinds of alkali sand.

The nearest water course to Death Valley is the Amargosa River, a little stream that trickles down in an enormous bed from away up among the mountains in Nevada. Centuries ago the Amargosa was a mighty, roaring torrent that eroded granite rocks and ate a river bed half a mile wide for over eighty miles. The Amargosa touches the extreme southwestern end of Death Valley, and in this locality lizards and venomous crawling things may be occasionally seen darting from under the rocks. In the same locality tiny rivulets of heavily charged borax water issue from the base of ancient volcanoes and form in pools. Hundreds of acres of the purest borax are created here by the intense evaporation, and large fortunes have been made by Californians, who haul the product across the

desert to the railroad station in Mojave.

Death Valley gets its name from its ghastly aspect, its desolation, and its deadly effect upon many a venturesome or ignorant mining prospector who has attempted to cross it in the summer, and who has died of thirst there. Among all the tales of grim hardships and dreadful suffering by emigrants to California before there were railroads west of the Missouri River, none is so pitiful as that of the party who got lost in Death Valley in 1849. There were five hundred emigrants in a caravan at Salt Lake City in August of that year. All were going to the gold fields of California. A division of opinion arose as to the safest and easiest trail across the trackless plains and the Sierras to the new El Dorado. Some two hundred of the party struck out for the southeast and found the old Santa Fe trail, which finally led them to southern California. The rest went plodding in a caravan across the wastes of southern Utah. There was nothing to show them the way through the lifeless, roasting valley, past the bald mountains, and then westward over the towering Sierras.

The caravan was in the land of thirst. For four months the starving, half-crazed men and women wandered hither and yon through the region of horror, seeking some pass between the mountains to the Pacific Ocean. Mirages led them vainly away from the trail. Their wagons fell apart from dryness, and horses daily fell under the withering heat. The oxen fell, and the stalwart men sickened and died in the camps. One day nine young men became separated from the main party, and years later their whitened bones were found in an extinct volcano crater, where they had crawled in their delirium and weakness.

For days the gaunt, weak men in the party went without food. The days were too hot to be out in the sun, and they confined their efforts to the nights for finding paths that might lead out of the roasting tomb.

At last eighty-two of the original party—now mere skeletons and so weak they could scarcely walk—found a passageway through the Funeral Mountains, and summoning all their little remaining strength, managed to get up and out of Death Valley into the cool and well-watered region of southern California, beyond the Sierras. One of the party, the Rev. J. W. Grier, weighed 188 pounds when he left Salt Lake City, and when he reached Los Angeles eighteen weeks later his weight was down to 92 pounds. Two of his brothers and one of his sisters-in-law died during the awful journey.

The story of the destroyer is not told without an account of Lieutenant Wheeler. Wheeler was a young officer fresh from West Point, who, immediately upon his graduation, in 1870, was assigned to a one-company post in western Nevada. After going through the loneliness of a Nevada winter in his little post, under direct command of his captain, a former West Point instructor, with whom he had quarreled at the academy, Wheeler came to an open personal breach with his captain in the spring and vowed henceforth he would speak no words to his superior other than those enjoined upon him by the military regulations. The captain, resenting his subordinate's silence, piled upon him every disagreeable, onerous and unnecessary duty conceivable.

In July, 1871, his captain ordered young Wheeler to take two men and search

for the most direct path across Death Valley. Wheeler marched off in the direction of the mantrap, and when he arrived at the edge of the valley of destruction he sought a guide. A halfbreed Mexican and Indian volunteered for \$20 to steer the party across. "Here is your money," shouted Wheeler, "and now I'll hold you to what you said. Start across."

The halfbreed, frightened at the earnestness of the man whom he had expected to hoodwink, began to back and fill on his offer. "Fix bayonets," ordered Wheeler to his two men. They did so. "Now march that man across that pit in front of you."

Toward nightfall the three started, the two soldiers with fixed bayonets, the guide in front of them. The next morning the two soldiers came back separately. One was utterly raving and permanently insane. The other, suffering from sun-stroke, drank a few drops from Wheeler's canteen, then lay down to rest in a boulder's shade. In the afternoon he was dead. Wheeler was never sane after his all-night vigil waiting by the side of Death Valley for his two men to come back. The guide wandered off from the two soldiers and was never seen alive again, although his wife identified his bones the following winter by means of a string of beads which he wore around his neck.



BORAX AND ITS PRODUCTION

Every man who went to California in the early '50s hoped to have a gold mine of his own, where he could settle down and become as wealthy as a national bank with little or no exertion. But unfortunately nature has not provided enough gold mines



TEAM OF TWENTY MULES HAULING BORAX FROM DEATH VALLEY.

Wagon wheels 7 feet and 5 feet in diameter; hubs 18 inches and 22 inches long; tires 8 inches wide, 1 inch thick; steel axles 3½ inches in diameter; bed 16 by 4 feet, 6 feet deep; weight 8,000 pounds; capacity 20,000 pounds; water tank wagon in rear.

to go all around. Consequently it was not long before the country was flooded with a tatterdemalion swarm of men, half miners, half tenderfeet, who, instead of being their own millionaires, were seeking an opportunity to relieve the ache under their belts. They were also bent on discovering something—that is what they had come for—and if it couldn't be a gold mine it might be a silver mine, a diamond drift or anything—they cared very little what. And that is how the vast borax deposits of the region came to be unearthed.

Previous to that time borax came mostly from Asia, and it was an expensive and little known commodity, sold from some small glass bottle on the apothecary's shelf. But within ten years after the time the disappointed gold miners found the deposits of borax it had become almost as common as table salt. Today the work of digging, transporting and refining it has grown to be a vast industry.

Borax was discovered out west by a man with an idea. Dr. John A. Veatch was a good deal of a geologist, and when he went west to look for gold and saw the vast stretches of parched and bitter alkaline plains he concluded from his knowledge of rock formations that borax could be found somewhere in the region. So he began to look for it deliberately, and one day early in 1856 his prospecting spade struck a small deposit in a dried lake bottom. It was not worth much, but it set a great crowd of miners peering about in the hope of finding better deposits. A few years after, some prospectors discovered that the bottoms of several California lakes were full of borax crystals, and from mining in the earth they began pumping water out of huge caissons set in the mud and then digging the earth up inside them and washing

out the crystals. Although the borax thus found was not pure it could be used for manufacturing fluxes of various sorts, and the substance was greatly cheapened.

But the greatest discovery was made in that great, hot region, "Death Valley," in California. It was made in a most romantic way. In 1880 Aaron Winters lived with his wife, Rosie, in a gulch known as Ash Meadows, not far from the deadly mouth of Death Valley. He was so fond of his wife that he would not allow her to be long absent from him, although their little hut on the side of the mountain was 100 miles from the nearest neighbor in a wild, rugged, forsaken country. One day a desert tramp came along and stopped over night at the Winters home and told the hunter about the borax deposits of Nevada. When he went away Winters thought that he had seen deposits of the kind described on his explorations down into Death Valley. Accordingly the strange couple went together to make the search, having previously provided themselves with certain test chemicals, which, when combined with borax and ignited, would produce a green flame.

Having procured a piece of the substance which he believed to be borax, Winters and his wife waited for nightfall to make the test. How would it burn? For years they had lived like Pintes on the desert, entirely without luxuries and often wanting for the very necessities of life. Would the match change all that? Winters held the blaze to the substance with a trembling hand, then shouted at the top of his voice: "She burns green, Rosie! We're rich! We're rich!"

They had found borax. The mine was sold for \$20,000, and Winters took Rosie to a ranch in Nevada, but she could not

stand prosperity, and a few years later she died.

Borax crystals are no longer dug even in California and Nevada, because the substance has been found in much more convenient form for refining in combination with lime. In this state it occurs in mountain strata, and it has to be mined exactly like silver or copper, but the cost is far greater. In the first place the region is totally destitute of water and fuel of any kind, both of which have to be transported long distances. Indeed, so dry is the country that workmen frequently go insane, and both men and horses perish miserably from thirst if water is not kept constantly at hand.

Besides all of the difficulties, accentuated by the necessity of having the finest machinery and skilled labor, all of the ore has to be transported for scores of miles over the desert before it reaches the railroads.

This work is mostly done by the aid of huge wagons with broad-tire wheels, weighing about 8,000 pounds each and having a carrying capacity of 20,000 pounds. To each wagon several teams of horses and mules are hitched, and the long trip across the desert and through perilous mountain passes begins. One of the wagons in the train is provided with a tank of water, for it would be impossible to travel without it. The drivers are rugged, fearless men, partaking of the characteristics of the country. They can swear as artistically at their mules as any teamsters in the world, and can drink as much whisky, but they are withal a hearty, hospitable set.

On reaching the railroad the ore from the great wagons is loaded on box-cars and transported several hundred miles to the refineries, one of the largest of which is located on San Francisco bay. Here the

rough, broken masses of brown rock are unloaded at the door of a long, shed-like building, and the process which is to transform it into beautiful crystals of borax is soon under way. The crude material first passes between the jaws of a rock-breaker, from which it comes out in small, pebble-like pieces. Then it goes into the hopper of a machine not unlike an old-fashioned buhr-stone flour-mill, where it is thoroughly pulverized. It now has about the appearance of buckwheat flour, and is ready for the final process of separating the borax.

To accomplish this it is thrown into a great steam chest or pressure boiler, called a digester, and carbonate soda in a fixed proportion is added. When heat is applied in the furnace below and the mass within the boiler is churned with plungers, the digestion in the big stomach begins. The carbonic acid in the carbonate of soda suddenly deserts the soda, and unites after many spurts and fizzings with the lime in the borax ore, which is nothing more than borate of lime. Then the boracic acid in the ore finds more attractive company with the deserted soda, and in the united state becomes bichlorate of sodium, which is only the aristocratic name for borax. It is still in solution, however, and as soon as it cools off it is run into great vats filled with a myriad of steel rods. On these rods the borax crystallizes just as rock candy clings to a string. When the borax is all out of solution the rods are withdrawn from the water, and the crystals of borax scraped off. By dissolving them again and recrystallizing, a purer form of borax is secured. When powdered it is ready for the market.

Borax is used in hundreds of different ways, and, as people become more familiar with it, the demand grows greater. The

great packers consume large quantities in the dry packing of meat for export, and iron and glass workers and enameling factories use it constantly as a flux.

But the greatest portion of the whole amount is consumed in the household. Not being a patented commodity it sells at its real market value, which is about 7 cents a pound. Its alkaline properties make it valuable for softening hard water, and for cleaning woodwork. Almost every housewife is familiar with it. It is also used in various ways as a medicine and in the toilet. It is also said to be death on insects of all kinds.

An artificial ivory, called lactitis, is now made of skimmed milk coagulated, mixed with borax, and submitted to tremendous pressure. This substance is used for comb, billiard balls and other articles.



THE GRAND CANYON OF ARIZONA

Travelers agree that the Grand Canyon of Arizona, formed where the Colorado river has carved a great channel for itself across the northwestern part of that territory, is the most wonderful of all scenic displays in the world. For many years this amazing chasm was unknown to white men or unvisited by them, but in more recent times trails were cut and then roads, and now a railway has been built until it may be viewed with entire comfort and ease by any one who takes the transcontinental journey by way of the railway which reaches the brink of the canyon. As access became easier and travelers began to increase in number, the beauties and grandeur of the place became better known.

To-day it is the favored destination of geologists, artists and explorers who find no other scene so worthy of their attention in all the world. Some of the most eminent literary men and graphic lecturers have journeyed thither, and their accounts, although falling far short of giving a com-

has published a book of great value, descriptive of that exploration and others which he made in succeeding years. The artist George Wharton James, some years later, lived for a considerable period on the brink of the Canyon and in its depths, studying its varied moods and painting it



By Courtesy of the Santa Fe Railway.

IN THE GRAND CANYON OF ARIZONA.

Showing the Colorado River in the inner gorge at the foot of Bright Angel Trail.

plete idea of the wonders of the place, are the next thing to a personal journey of investigation.

The first real exploration of the Grand Canyon was made by Major J. W. Powell in 1869, and since that time no other exploration has equaled his journey in daring or surpassed it in achievements. He

in intimacy, with the result that he too issued a beautiful volume which serves as the best reference book and guide to the region. Other minor books have been published, including artistic and valuable guides issued by the railway company. Magazine articles have been contributed by such authors as C. F. Lummis, Harriet

Monroe, Joaquin Miller, Hamlin Garland, Charles Dudley Warner and others. Poets, too, as well as painters and photographers, have lent their art in the effort to interpret and picture the glories of the Canyon. It is a subject of never failing interest and one to which no one has yet done justice.

Few men have known the Grand Canyon of Arizona better than did C. A. Higgins, who camped in it, traveled all its trails, and studied it in every one of its changing conditions. An artist by temperament, he saw the splendid scene in all its significance, and with a graphic pen told what he saw in modest fashion. The account which follows is condensed from an article by Mr. Higgins.

"The Colorado is one of the great rivers of North America. Formed in southern Utah by the confluence of the Green and Grand, it intersects the northwestern corner of Arizona, and, becoming the eastern boundary of Nevada and California, flows southward until it reaches tidewater in the Gulf of California, Mexico. It drains a territory of 300,000 square miles, and, traced back to the rise of its principal source, is 2,000 miles long. At two points, Needles and Yuma on the California boundary, it is crossed by a railroad. Elsewhere its course lies far from Caucasian settlements and far from the routes of common travel, in the heart of a vast region fenced on the one hand by arid plains or deep forests and on the other by formidable mountains.

"The early Spanish explorers first reported it to the civilized world in 1540, two separate expeditions becoming acquainted with the river for a comparatively short distance above its mouth, and another, journeying from the Moki Pueblos

northwestward across the desert, obtaining the first view of the Big Canyon, failing in every effort to descend the canyon wall, and spying the river only from afar. Again, in 1776, a Spanish priest traveling southward through Utah struck off from the Virgin River to the southeast and found a practicable crossing at a point that still bears the name 'Vade de los Padres.'

"For more than eighty years thereafter the Big Canyon remained unvisited except by the Indian, the Mormon herdsman and the trapper, although the Sitgreaves expedition of 1851, journeying westward, struck the river about 150 miles above Yuma, and Lieutenant Whipple in 1854 made a survey for a practicable railroad route along the thirty-fifth parallel, where the Santa Fe railway has since been constructed.

"The establishment of military posts in New Mexico and Utah having made desirable the use of a waterway for the cheap transportation of supplies, in 1857 the War Department dispatched an expedition in charge of Lieutenant Ives to explore the Colorado as far from its mouth as navigation should be found practicable. Ives ascended the river in a specially constructed steamboat to the head of Black Canyon, a few miles below the confluence of the Virgin River in Nevada, where further navigation became impossible; then, returning to the Needles, he set off across the country toward the northeast. He reached the Big Canyon at Diamond Creek and at Cataract Creek in the spring of 1858, and from the latter point made a wide southward detour around the San Francisco Peaks, thence northeastward to the Moki Pueblos, thence eastward to Fort Defiance, and so back to civilization.

"That is the history of the explorations

of the Colorado up to forty years ago. Its exact course was unknown for many hundred miles, even its origin being a matter of conjecture. It was difficult to approach within a distance of two or three miles from the channel, while descent to the river's edge could be hazarded only at wide intervals, inasmuch as it lay in an appalling fissure at the foot of seemingly impassable cliff terraces that led down from the bordering plateau; and to attempt its navigation was to court death. It was known in a general way that the entire channel between Nevada and Utah was of the same titanic character, reaching its culmination nearly midway in its course through Arizona.

"In 1869 Major J. W. Powell undertook the exploration of the river with nine men and four boats, starting from Green River City, on the Green River, in Utah. The project met with the most urgent remonstrance from those who were best acquainted with the region, including the Indians, who maintained that boats could not possibly live in any one of a score of rapids and falls known to them, to say nothing of the vast unknown stretches in which at any moment a Niagara might be disclosed. It was also currently believed that for hundreds of miles the river disappeared wholly beneath the surface of the earth.

"Powell launched his flotilla on May 24, and on August 30 landed at the mouth of the Virgin River, more than one thousand miles by the river channel from the place of starting, minus two boats and four men. One of the men had left the expedition by way of an Indian reservation agency before reaching Arizona, and three, after holding out against unprecedented terrors for many weeks, had finally become

daunted, choosing to encounter the perils of an unknown desert rather than to brave any longer the frightful menaces of that Stygian torrent. These three, unfortunately making their appearance on the plateau at a time when a recent depredation was colorably chargeable upon them, they were killed by Indians, their story of having come thus far down the river in boats being wholly discredited by their captors.

"Powell's journal of the trip is a fascinating tale, written in a compact and modest style, which, in spite of its reticence, tells an epic story of purest heroism. It definitely established the scene of his exploration as the most wonderful geological and spectacular phenomenon known to mankind, and justified the name which had been bestowed upon it—the Grand Canyon, sublimest of gorges, Titan of chasms. Many scientists have since visited it, and, in the aggregate, a large number of unprofessional lovers of nature; but until a few years ago no adequate facilities were provided for the general sight-seer, and the world's most stupendous panorama was known principally through report, by reason of the discomforts and difficulties of the trip, which deterred all except the most indefatigable enthusiasts. Even its geographical location is the subject of widespread misapprehension.

"Its title has been pirated for application to relatively insignificant canyons in distant parts of the country, and thousands of tourists have been led to believe that they saw the Grand Canyon, when, in fact, they looked upon a totally different scene, between which and the real Grand Canyon there is no more comparison 'than there is between the Alleghenies or Trosachs and the Himalayas.' There is but one Grand

Canyon. Nowhere in the world has its like been found.

"Stolid, indeed, is he who can front the awful scene and view its unearthly splendor of color and form without quaking knee or tremulous breath. An inferno, swathed in soft celestial fires; a whole chaotic underworld, just emptied of primeval floods and waiting for a new creative word; ending all sense of perspective or dimension, outstretching the faculty of measurement, overlapping the confines of definite apprehension; a boding, terrible thing, unflinchingly real, yet spectral as a dream. The beholder is at first unimpressed by any detail; he is overwhelmed by the ensemble of a stupendous panorama, a thousand square miles in extent, that lies wholly beneath the eye, as if he stood upon a mountain peak instead of the level brink of a fearful chasm in the plateau, whose opposite shore is thirteen miles away. A labyrinth of huge architectural forms, endlessly varied in design, fretted with ornamental devices, festooned with lacelike webs formed of talus from the upper cliffs, and painted with every color known to the palette in pure transparent tones of marvelous delicacy. Never was picture more harmonious, never flower more exquisitely beautiful. It flashes instant communication of all that architecture and painting and music for a thousand years have gropingly striven to express. It is the soul of Michael Angelo and of Beethoven.

"A canyon, truly, but not after the accepted type. An intricate system of canyons, rather, each subordinate to the river system in the midst, which in its turn is subordinate to the whole effect. That river channel, the profoundest depth, and actually more than 6,000 feet below the point

of view, is in seeming a rather insignificant trench, attracting the eye more by reason of its somber tone and mysterious suggestion than by any appreciable characteristic of a chasm. It is perhaps five miles distant in a straight line, and its uppermost rims are nearly 4,000 feet beneath the observer, whose measuring capacity is entirely inadequate to the demand made by such magnitudes. One can not believe the distance to be more than a mile as the crow flies, before descending the wall or attempting some other form of actual measurement.

"Mere brain knowledge counts for little against the illusion under which the organ of vision is here doomed to labor. Yonder cliff, darkening from white to gray, yellow and brown as your glance descends, is taller than the Washington monument. The Auditorium in Chicago would not cover one-half its perpendicular span. Yet it does not greatly impress you. You idly toss a pebble toward it, and are surprised to note how far the missile falls short. By and by you will learn that it is a good half mile distant, and when you go down the trail you will gain an abiding sense of its real proportions. Yet, relatively, it is an unimportant detail of the scene. Were Vulcan to cast it bodily into the chasm directly beneath your feet, it would pass for a boulder, if, indeed, it were discoverable to the unaided eye.

"Yet the immediate chasm itself is only the first step of a long terrace that leads down to the innermost gorge and the river. Roll a heavy stone to the rim and let it go. It falls sheer the height of a church or an Eiffel Tower, according to the point selected for such pastime, and explodes like a bomb on a projecting ledge. If, happily,

any considerable fragments remain, they bound onward like elastic balls, leaping in wild parabola from point to point, snapping trees like straws; bursting, crashing, thundering down the declivities, until they make a last plunge over the brink of a void; and then there comes languidly up the cliff sides a faint roar, and your boulder that had withstood the buffets of centuries lies scattered as wide as Wyeliffe's ashes, although the final fragment has lodged only a little way, so to speak, below the rim. Such performances are frequently given in these amphitheatres without human aid, by the mere undermining of the rain, or perhaps it is here that Sisyphus rehearses his unending task. Often in the silence of the night some tremendous fragment has been heard crashing from terrace to terrace with shocks like thunder peal.

"The spectacle is so symmetrical, and so completely excludes the outside world and its accustomed standards, it is with difficulty one can acquire any notion of its immensity. Were it half as deep, half as broad, it would be no less bewildering, so utterly does it baffle human grasp."

Within the last few years a hotel has been built on the very verge of the canyon, and a railway has been built which connects directly with the transcontinental trains at the station of Williams, Arizona. This makes the journey available for any traveler, and since the train service to the rim of the canyon was established, visitors have multiplied rapidly. This is one of nature's marvels which can not be spoiled by the arrival of numbers or the building of hotels, so enormous is it, and with the Colorado river still roaring in its channel, continuing the mighty work of erosion, we may presume that the Grand Canyon of

Arizona will remain as long as the world lasts, carving a deeper gorge, century by century, inspiring profound emotions in the beholders after generations have passed.



THE DAKOTA "BAD LANDS"

Hardly more than half a century ago, some of our greatest statesmen earnestly opposed any legislation or expenditure for the development or the exploration of the great region of the United States west of the Mississippi river. Even Daniel Webster, when the first transcontinental railway was under discussion in Congress, declared that he would never vote to appropriate one cent to connect the east with the Pacific coast, across thousands of miles of utterly worthless, uninhabitable desert country. A few government exploring parties had traversed the great west and reported on it, and accounts of various regions had come from daring pioneers and explorers who had forced their way beyond the frontier, out of sheer joy of life in the wilderness. This was virtually the extent of knowledge of what is now the prosperous and populous land of the west.

Such areas as what we know as the "Bad Lands" of Dakota, the "Terres Mauvaises" of the French voyageurs, went far to justify the bad name which was ascribed to the entire country before it was realized that these peculiar formations were but a small portion of the whole. We can well spare a little of the vast domain which our country holds between the Mississippi and the Pacific to display the varied works of nature in different humors. The mountain ranges, the canyons, the waterfalls, the glow of color on the rock walls of cliff and gorge

—these all have their value as truly as do the wide and fertile prairies or the mighty forests. The Yosemite Valley, the Yellowstone National Park, the Grand Canyon of Arizona, the Garden of the Gods and the Bad Lands of Dakota are wonderful and beautiful instances of the variety of nature's impulses and works when forces are unrestrained.

The Bad Lands occupy a large part of southwestern South Dakota, between the

vegetation. The richness of the fossil beds has attracted the attention of many scientific expeditions since access to this strange region became easy. The great universities of the east and west send parties of their geological students here every year, under the leadership of their professors, to delve into the mysteries of the past as they are indelibly recorded in the eternal rock.

But the scientific visitor is not the only one well repaid by a journey to the Bad Lands. Nature's freakish humor here has made a multitude of interesting things even in the worst of the barrenness and desolation. Grotesque carvings in the rocks; the tangle of canyons, cliffs and buttes; the glow of varied color that meets the eye; the pure air and the beautiful sunsets, all unite to make the region one of great interest even to the layman.



IN THE DAKOTA "BAD LANDS."

Missouri river and the Black Hills. They are tracts of barrenness, reminders of a prehistoric age, and of special interest to the geologist, as the place of deposit for petrifications, which they have hidden away for ages under as forbidding ground as can well be imagined. They are a picture of desolation, seamed and gashed by the elements, ribbed and trussed by strata of fossils great and small, which seem to hold the sterile soil together, while cactus and sage-brush are the only visible forms of

Historically the Bad Lands are closely associated with the Black Hills, which are their neighbors. During the period of frontier warfare, when the gold discoveries around Deadwood had stimulated the invasion of white men to violate their treaties with the Indians, these regions were citadels for the savages. Among the labyrinths of the hills and gulches they could evade pursuit or plan their raids to best advantage. Custer, Harney, Miles and the other great campaigners of the west found their task a difficult one to conquer the red

enemy in such a country and establish him in peace on the reservations to the east of the Black Hills. Here was where Sitting Bull fought some of his greatest fights. Now the Bad Lands and the Black Hills alike are regions of peace, the latter busy with mining and commerce, the former left in virtual solitude except for the visits of interested geologists and tourists.



CRATER LAKE, AN OREGON WONDER

The great west has furnished the world with some of the most marvelous of the works of nature. Stupendous canyons and gorges, big trees thousands of years old, cataracts hundreds of feet in height, mountain ranges, plains, deserts, salt lakes, geysers and other natural objects in endless variety, attract the traveler from afar. Little known, and difficult of access because of its distance from a railway and its rugged surroundings, is Crater Lake, in the state of Oregon, one of the most wonderful of all the sights beheld by the energetic traveler.

Crater Lake is situated in the heart of the mountains of southwestern Oregon, about seventy miles from the California line, and twice as far from the Pacific ocean. It is necessary to drive eighty miles from the nearest railway station to reach it, and though the highway is a good military road running to Fort Klamath on the Klamath Indian reservation, not many travelers make the journey. It was discovered on June 12, 1853, by a party of prospectors. The Indians of southern Oregon have known of it for ages, but until recent years none have seen it, for the reason that

a tradition, handed down from generation to generation, described it as the home of myriads of sea-devils, and it was considered certain death for any brave even to look upon it. The lake was first explored in 1886 by officers of the United States geological survey. W. G. Steel of Portland, Oregon, long an officer of the Oregon Alpine Club, accompanied the expedition to the lake, which he had visited the previous year, and after a period of exploration wrote an account of the wonders of the place, from which the following facts have been drawn.

The lake is almost egg-shaped, ranging northeast and southwest, and is seven miles long by six in width. The surface of the water is 6,251 feet above sea level, and it is completely surrounded by a wall of cliffs from 500 to more than 2,000 feet high, which are scantily covered with coniferous trees. At times, when gazing from the surrounding wall, the skies and cliffs are seen perfectly mirrored in the smooth and glassy surface over which the mountain breeze creates scarce a ripple, and it is with great difficulty the eye can distinguish the line dividing the cliffs from their reflected counterfeits.

To the southwest is Wizard Island, 845 feet high, circular in shape, and slightly covered with timber. In the top of the island is a depression or crater—the Witches' Cauldron—100 feet deep and 475 feet in diameter. This was evidently the last smoking chimney of a once mighty volcano. The base of the island is covered with very heavy and hard rocks, with sharp and unworn edges, over which but few visitors have clambered. Farther up are deep beds of ashes, and light, spongy rocks and cinders, giving evidence of intense

heat. Within the crater, as without, the surface is entirely covered with volcanic rocks.

Directly north of the island is Llao Rock, a grand old sentinel, reaching to a perpendicular height above the surface of the lake of more than 2,000 feet. From the top of it you can drop a stone and it will grow smaller and smaller, until your head begins to swim and you see the stone become a mere speck and fade entirely from view; and at last, nearly half a mile below, it strikes the unruffled surface of the water and sinks forever from sight in the depths of an almost bottomless lake.

There is probably no other point of interest in America that so completely overcomes the ordinary Indian with fear as Crater Lake. From time immemorial, no power has been strong enough to induce him to approach within sight of it. For a paltry sum he will engage to guide you thither, but before you reach the mountain top will leave you to proceed alone. To the savage mind it is clothed with a deep veil of mystery, and is the abode of all manner of demons and unshapely monsters.

When the exploration of the lake was made, boats had to be built in Portland, Oregon, transported 340 miles by rail, and then carried to the lake on wagons, 100 miles into the mountains, where they were launched over sheer cliffs 1,000 feet high. Soundings were made all over the lake, and the greatest depth found was 2,008 feet, while 600 feet was the depth of the shallowest water. The shore is entirely encircled with precipitous cliffs, coming down at but one place as low as 500 feet above the water. On one side, however, it was

possible to make trails to the water's edge. Grottoes, bays, islands, cliffs and many strange formations help to magnify the beauty of the scene.

In closing his account of this phenomenon, Mr. Steel says in part: "Crater Lake is but a striking memento of a dead past. Imagine a vast mountain, six by seven miles through at an elevation of 8,000 feet, with the top removed and the inside hollowed out and filled with the clearest water in the world to within 2,000 feet of the top; then place a round island in one end, 845 feet high, in which dig a circular hole tapering to the center like a funnel, 100 feet deep and 475 feet in diameter, and you have a perfect representation of Crater Lake. The surface of the water is twenty-three feet higher than the summit of Mount Washington. What an immense affair it must have been, ages upon ages ago, when, long before the hot breath of a volcano soiled its hoary head, standing as a prond monarch, with its feet upon earth and its head in the heavens, it towered far, far above the mountain ranges, aye, looked far down upon the snowy peaks of Hood and Shasta, and snuffed the air beyond the reach of Everest. Then streams of fire began to shoot forth, great seas of lava were hurled upon the earth beneath. The elements seemed bent upon establishing hell upon earth, and fixing its throne upon this great mountain. At last the foundations gave way and it sank forever from sight, down, down, down, deep into the bowels of the earth, leaving a great black, smoking chasm, which succeeding ages filled with pure, fresh water, giving to our day and generation one of the most beautiful lakes within the vision of man."

CAUSE OF EARTHQUAKES AND VOLCANOES

The great phenomena of nature in the course of ages undergo many modifications. We do not expect that there will ever again be an age of ice and glaciers, a carboniferous age, an age of gigantic animals and reptiles, nor yet a general flood over the continents. And yet some of the great forces of nature, hardly second in magnitude to these manifestations, repeat themselves at frequent intervals. Volcanoes and earthquakes, for instance, in some parts of the globe recur with great frequency, while elsewhere, though they may be virtually unknown, slight shocks are sometimes felt. It often happens that just as the world has settled to a belief that the day of great disasters is past, some vast catastrophe occurs which destroys life and property through a large area, and proves that these internal forces have been but slumbering and are not extinct. Such was the circumstance with the terrible eruptions of May 8, 1902, in the West Indies. Mount Pelee, on the island of Martinique, and La Soufriere on the island of St. Vincent suddenly burst their bounds, and almost in an instant destroyed thousands of lives and at least one beautiful and prosperous city. It has been many years since the world has seen a catastrophe equal to this, and it will be long before mankind rests again in such complacent assurance that there is no danger in living under the shadow of a sleeping volcano.

The earth, like the human body, is subject to constitutional derangements. The fires and the impurities of the blood manifest themselves in the shape of boils and eruptions upon the human body. The in-

ternal heat of the earth, and the chemical changes which are constantly taking place in the interior of the globe, manifest themselves outwardly in the form of earthquakes and volcanoes. In other words, a volcano is a boil or eruption on the earth's surface.

Scientists have advanced many theories concerning the primary causes of volcanoes, and many explanations relating to the igneous matter discharged from their craters. Like the doctors who disagree in the diagnosis of a human malady, the geologists and volcanists are equally unable to agree in all details concerning this form of the earth's ailment. After all theories relating to the cause of volcanoes have been considered, the one that is most tenable, and is sustained by the largest number of scientific men, is that which traces volcanic effects back to the old accepted cause of internal fires in the center of the earth. Only in this way can the molten streams of lava emitted by volcanoes be accounted for. The youngest student of familiar science knows that heat generates an upward and outward force, and, like all forces, it follows the path of least resistance. This force is always present in the internal region of the earth, which for ages upon ages has been gradually cooling from its poles toward the center. When conditions occur by which it can outwardly manifest itself, it follows the natural law and escapes where the crust of the earth is thinnest.

But something more than the mere presence of internal fire is necessary to account for volcanic action, although it may, in a large degree, account for minor seismic convulsions in the form of an earthquake. The elements which enter into the source

of a volcanic eruption are fire and water. The characteristic phenomenon of a volcanic eruption is the steam which issues from the crater before the appearance of the molten lava, dust, ashes and scoria. This accepted theory is plainly illustrated in the eruption of a geyser, which is mere-

simplest form, is likewise illustrated in a boiler explosion. Observations of the most violent volcanic eruptions show them to be only tremendous boiler explosions at a great depth beneath the earth's surface, where a great quantity of water has been temporarily imprisoned and suddenly con-

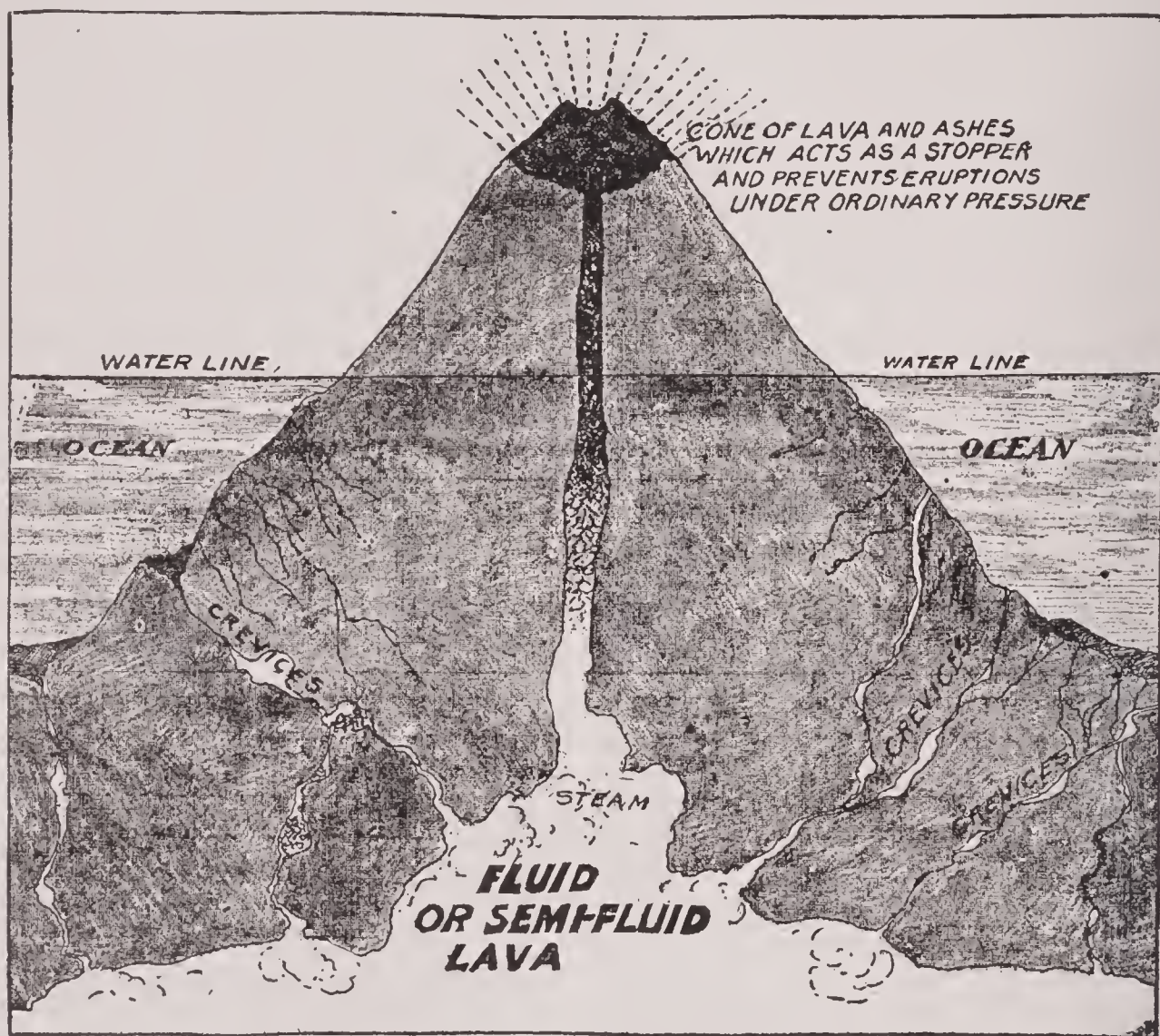


DIAGRAM SHOWING CAUSE OF A VOLCANO.

The water percolating through the crevices reaches the molten rock, when steam is generated and the pressure blows the head off the mountain.

ly a small water volcano. The water basin of a geyser is connected by a natural bore with a region of great internal heat, and as fast as the heat turns the water into steam columns of steam and hot water are thrown up from the crater.

One form of volcanic eruption, and its

verted into steam. In minor eruptions the presence of steam is not noticeable in such quantities; which is simply because the amount of imprisoned water was small and the amount of steam generated was only sufficient to expel the volcanic dust and ashes which formed beneath the

earth's surface and the internal fires of the volcano. The flow of lava which follows violent eruptions is expelled by the outward and upward force of the great internal heat, through the opening made by the steam which precedes it.

The two lines of volcanoes, one north and one south, the other east and west, which intersect in the neighborhood of the West Indies, follow the course where the crust of the earth is thinnest, and where great bodies of water lie on shallow parts of the ocean bed. The terrific heat of the earth's internal fires is sufficient to cause crevices, leading from these bodies of water to the central fires of the volcano, and the character of the volcanic eruption is determined largely by the size of the crevices so created and the amount of water which finds its way through them. The temperature of these internal fires can only be guessed at, but some idea may be formed of their intense heat from streams of lava emitted from the volcano. These will sometimes run ten or twelve miles in the open air before cooling sufficiently to solidify. From this it will be seen that the fires are much hotter than are required merely to reduce the rock to a liquid form. From this fact, too, may be seen the instantaneous action by which the water seeping or flowing into the heart of the volcano is converted into steam and a tremendous explosive power generated.

At a depth of about thirty miles, the internal heat of the earth is probably great enough to melt all known substances. Confinement may keep in a rigid condition the material which lies beneath the solid crust, but if an avenue of escape is once opened the stuff will soften and ooze upward. There is a growing tendency, more-

over, to recognize the importance of gravitation in producing eruptions. The weight of several miles of rock is almost inconceivable, and it certainly ought to compel potentially plastic matter to rise through any crevice that might be newly formed. Some authorities regard this as the chief mechanical agent in an eruption, at least when there is a considerable outpouring of lava.

As to the extent to which water operates, there is some lack of harmony among volcanists. Some point to the fact that many volcanoes are situated near the coasts of continents or on islands where leakage from the ocean may possibly occur. Others regard water as not the initial factor, but an occasional though important reinforcement. They suggest that when the molten rock has risen to a considerable distance it encounters water, and steam is then suddenly generated. The explosive effects which ensue are of two kinds. By the expansion of the moisture which some of the lava contains the latter is reduced to a state of powder and thus originate the enormous clouds of fine dust which are ejected. Shocks of greater or less violence are also produced. The less severe ones sound like the discharge of artillery and give rise to tremors in the immediate vicinity. In extreme cases enough force is developed to rend the walls of the volcano itself.

The precise manner in which the plastic inside of the terrestrial shell gets access to the surface is not entirely clear. Nevertheless it is possible to get some light on the matter. It is now well known that in many places there are deep cracks or faults in the earth's crust. Some of them in the remote past have been wide and deep

enough to admit molten material from below. The Palisades of the Hudson are believed to have been formed by such an intrusion, the adjacent rock on the eastern face having since been worn away by the water or other agents. It has been observed that many volcanoes are distributed along similar faults.

The existence of a chain of volcanic islands in the West Indies suggests the

about the earth. One girdles the earth north and south, extending through Tierra del Fuego (called "land of fire" because of its volcanoes), Mexico and the West Indies, the Aleutian islands and down the islands of the coast of Asia and the East Indies through Australia to the south pole. The other passes east and west through Hawaii, Mexico, the West Indies, Italy and Asia Minor. These two circles inter-



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RUINS OF ST. PIERRE, MARTINIQUE.

Showing steamship Roraima burning in the harbor.

probability that it follows a crack of great antiquity, though the issue of lava and ashes for several centuries may have been limited to a few isolated points. Just how these vents have been reopened is one of the most difficult questions still left for investigation. Given a line of weakness in the rocks though, and a susceptibility to fresh fracture is afforded.

There are two great circles of volcanoes

sect at two points. One of these is in the West Indies, the scene of this recent terrible disaster, and the other is in the East Indies, where eruptions are frequent. It is just at these points of intersection of the two volcanic rings that we expect unusual volcanic activity, and it is there that we find it. All this is of interest, showing that the earth is still in the process of formation, just as much as it was hundreds of

centuries ago. We see the same thing in Yellowstone Park. There most decided changes have taken place even in the last few years.

There has been more or less theorizing as to volcanic disturbances moving in cycles, but it cannot be proved. There is no doubt, however, that eruptions sometimes break forth simultaneously in widely distant portions of the earth. A sympathetic relation of this kind has long been known between Mount Hecla in Iceland and Mount Vesuvius in Italy, and it is very probable that the volcanoes of the West Indies have some such sympathetic relation with the volcanoes of Central America and southern Mexico, which were in eruption about the same time.



FAMOUS VOLCANIC AND EARTHQUAKE DISASTERS

The cataclysms of nature which we know as earthquakes and volcanoes are closely allied, although widely different in their effects. The terrible disasters of the past that have come down to us through the centuries, and those of more recent times, have sometimes been of one character and sometimes of another, although always incited by the same internal convulsions of the earth.

In the history of earthquakes nothing is more remarkable than the extreme fewness of those recorded before the beginning of the Christian era, in comparison with those that have been registered since that time. This may be partly accounted for by the fact that before the birth of Christ there was but a small portion of the habitable surface of the globe known to those who

were capable of handing down a record of natural events. The vast increase in the number of earthquakes in recent times is, therefore, undoubtedly due to the enlargement of our knowledge of the earth's surface and to the greater freedom of communication which we now have.

Earthquakes might have been as frequent throughout the entire globe in ancient times as now, but the writers of the Bible and the historians of Greece and Rome might have known nothing of their occurrence. Even at the present time an earthquake might happen in central Africa or in central Asia of which we would never hear, and the recollection of which might die out among the natives in a few generations. In countries, too, which are thinly inhabited and where there are no large cities to be overthrown, even great earthquakes might happen almost unheeded. The few inhabitants might be awe-struck at the time, but if they sustained no personal harm, the violence of the commotion and intensity of their terror would soon fade from their memory.

Doctor Daubeny, in his work on volcanoes, cites an example of this complete oblivion even when the event must have occurred not far from the ancient center of civilization. The town of Lessa, between Rome and Naples, and not far from Gaeta, stands on an eminence composed of volcanic rocks. In digging the foundation for a house at this place some years ago, there were discovered many feet beneath the present surface the remains of an amphitheater and a chamber with antique frescoes. Yet there is not only no existing account of the destruction of a town on this site, but not even a tradition of any volcanic eruption in the neighborhood.

The earthquake which destroyed Sodom and Gomorrah is not only the oldest on record, but one of the most remarkable. It was accompanied by a volcanic eruption, it upheaved a district of several hundred square leagues, and caused the subsidence of a tract of land not less extensive, altering the whole water system and the levels of the soil. The south of Palestine contained a splendid valley, dotted with forests and flourishing cities. This was the valley of Siddim, in which reigned the confédérate sovereigns of Sodom, Gomorrah, Adniah, Zeboiim and Zoar. They had joined forces to resist the king of the Elamites, and they had just lost the decisive battle of the campaign when the catastrophe which destroyed the five cities and spread desolation in the flourishing valley took place. As the sun arose the ground trembled and opened, red hot stones and burning cinders, which fell like a storm of fire upon the surrounding country, being emitted from the yawning chasm.

This was a sudden volcanic eruption like that which destroyed in one night the cities of Pompeii and Herculaneum. When, after the disaster, the inhabitants of neighboring regions came to visit the scene of it, they found the whole aspect of the district altered. The valley of Siddim had ceased to exist, and an immense sheet of water covered the space which it once occupied. Beyond this vast reservoir, to the south, the Jordan, which formerly fertilized the country as far as the Red Sea, had also disappeared. The whole country was covered with lava, ashes and salt. All the cultivated fields, the hamlets and villages had been destroyed. As it was upon the morrow of the catastrophe, so the region has

remained, with its calcined rocks, its blocks of salt, its masses of black lava, its rough ravines, its sulphurous springs, its boiling waters, its bituminous marshes, its riven mountains, and its vast Lake Asphaltite, which is the Dead Sea.

The destruction of Pompeii and Herculaneum by the eruption of Mount Vesuvius on the 23d of August, A. D. 79, is the most interesting of all such disasters. We have the distinct advantage of detailed descriptions of it written by eminent historians and authors of the day, who were eye witnesses, and whose writings were preserved with care. In addition, within the last century Pompeii has been systematically excavated. The work has been slow, though continuous, and great progress has been made in disinterring the buried city. To-day it is a municipal museum of the Roman Empire as it was eighteen hundred years ago. The architecture is almost unmarred; the colors of decorated tiles on the walls are still bright; the wheel-marks in the roads are fresh looking. The picture of domestic life as it was is complete, except for the people who were destroyed or driven from the city. No other place in all the world so completely portrays that period of the past to us as does Pompeii, overwhelmed by Vesuvius, hidden for centuries, and now once more in view to the world to-day.

Mount Ætna, on the Italian island of Sicily, has been active for at least twenty-five centuries, with a historical record of seventy-eight distinct eruptions. Some of these have been disastrous in their destruction of life and property, and many thousands of persons have been killed as a result of these eruptions.

Lisbon, the beautiful capital of Portu-

gal, on the Tagus River, has been devastated by earthquakes and tidal waves more than once. The greatest of these was the appalling disaster of 1755, when in a few moments 60,000 lives were lost, either by the destruction of the city itself, in the falling buildings, or by drowning in the tidal wave that swept over the shattered

earthquakes and volcanic eruptions. Some of these have destroyed prosperous cities and thousands of lives. The last great earthquake in Japan was in 1891, when 40,000 houses were thrown down and about 24,000 persons were killed and wounded. Owing to the frequency of earthquake shocks in Japan, the study of



RUINS OF OZAKI, JAPAN, AFTER THE GREAT EARTHQUAKE.

metropolis. The portion of the earth's surface convulsed by this earthquake is estimated to have been four times greater than the whole extent of Europe. The earthquake was felt in the West Indies, Canada, Scotland, Sweden, Germany and Morocco.

India, Turkey, Persia and Japan have been the scene of numerous destructive

their causes and effects has had a great deal of attention there since the introduction of modern science into the island empire. The Japanese have proved as energetic in this direction as they are in purely material progress on lines of western civilization, and already they are recognized as the most advanced of all people in the

world in their study of the phenomena of earthquakes and volcanoes.

The greatest single volcanic explosion recorded in the history of the world occurred in 1883, beginning on the afternoon of Sunday, August 26, on the island of Krakatoa, in the Malay archipelago of the East Indies. Krakatoa is one of a group of volcanic islands in Sunda strait, between Sumatra and Java. The volcanic cone of this island had been agitated for some months prior to the date of the greatest eruption, and when, finally, nature's forces exploded themselves without restraint, all records had been broken. The entire series of grand phenomena extended over a little more than thirty-six hours. From sunset on Sunday till midnight the tremendous detonations followed each other so quickly that a continuous roar may be said to have issued from the island. The distance of ninety-six miles from Krakatoa was not sufficient to permit sleep to the inhabitants of Batavia. All night volcanic thunders sounded like the discharge of artillery at their very doors.

On the next morning there were four mighty explosions. The third one was of appalling violence and it gave rise to the most far reaching effects. The cloud of smoke, vapor and dust in the air was blown up to a height of seventeen miles into space. The volcanic ash which fell upon the neighboring islands within a circle of nine and a half miles radius was sixty-five to 130 feet thick. Masses of floating pumice encumbered the strait, and the coarser particles of this ash fell over a known area equal to the whole of the New England States, New York, New Jersey, Pennsylvania, Ohio, Indiana and Illinois. It is calculated that the matter so ejected must

have been considerably over a cubic mile in volume. The sound itself of this horrible explosion was heard by trustworthy witnesses at various places to a distance of nearly 3,000 miles and the atmospheric wave caused by the mighty outburst passed seven times around the world and left its record on the instruments in various observatories before it finally subsided.

At least 36,000 lives were lost. The island itself was completely changed. The whole northern and lower portion of it vanished except an isolated rock ten yards square and projecting out of the ocean with deep water all around it. What a tremendous work this must have been is attested by the fact that where Krakatoa island, girt with luxuriant forests, once towered from 300 to 1,400 feet above the sunlit waters, it is now in some places more than 1,000 feet below them. Krakatoa has gained undying fame as the island that blew its own head off.

Under the American flag we are ourselves the possessors of some of the greatest active volcanoes in the world, and the greatest of all craters, the latter extinct, indeed, for many years, but with a latent power that no one could conceive should it once more be in activity. Hawaii, "Paradise of the Pacific," raised by the fires of inner earth out of the depths of the ocean centuries ago, has become in recent years a smiling land of tropic beauty, and an American island possession. It is a land of great volcanoes, sometimes slumbering and again pouring forth floods of molten fire to overwhelm the peaceful villages and arouse the superstitious fears of the natives. Alaska, too, is a region of great eruptive activity, the Aleutian is-

lands being raised from the bed of the Pacific by the same natural forces.

The cities of Peru, Chile and the other South American republics have frequently suffered earthquake shocks and tidal waves. Lima, Callao and Caracas have been devastated at different times. The Isthmus of Panama, the Central American republics and Mexico have likewise suffered. The great mountain range which connects our own Rocky Mountains with the Andes by way of Mexico and Central America, is largely volcanic in its character, and eruptions of greater or less violence are not uncommon. Farther north in the United States the Rocky mountains and the Sierras have many volcanic peaks, happily extinct for many years. Even Mount Hood and Mount Ranier, near the cities of Portland, Oregon, and Tacoma, Washington, are well recognized as volcanic, and, indeed, they emit smoke and sulphurous vapor at all times, though there has been no eruption within the memory of man. If they should awaken, the danger to the populous cities of the northwest would be great.

Most recent of all great volcanic eruptions was that of May, 1902, in the Caribbean Sea, when the islands of Martinique and St. Vincent were devastated and many thousands of lives were lost. The scenes of that terrible catastrophe, in which the city of St. Pierre was overwhelmed and hardly one person escaped alive, have been graphically recorded by the descriptive and scientific investigators who hastened to the place, and by those who, upon ships in the harbors or in other places of partial safety, were eye witnesses. It would be a happy condition if we could be assured that never again would such a

blighting disaster befall any community. But the irresistible forces of nature, although dormant, are never extinct, and it is impossible to promise immunity.



AROUND THE SOUTH POLE

For centuries adventurous navigators have sought to explore the far north in the effort to discover the North Pole, and learn the conditions surrounding the polar regions. The South Pole has not attracted as much attention for various manifest reasons. The populated continents of Europe, Asia, and North America surround the North Pole, and offer means of comparatively close approach to it, so that the explorations can be made for a great distance by land, with some hope of escape in the event of disaster. There was a commercial reason, too, why the far north should be explored in the effort to find a track for vessels desiring to pass from the Atlantic to the Pacific, either by a northwestern or a northeastern course, which would be many thousands of miles shorter than the great detour by way of Cape Horn or the Cape of Good Hope. In the far north, too, man, animals and some vegetation served to make explorations easier. The Lapp and the Eskimo, the fox and the deer, the bear and the muskox, were almost always to be found for assistance or for food. It is said that man has never yet gone northward so far as not to find vegetation of some kind, the humble flower, the hardy grass, the resolute lichen. Explorers have gone within 400 miles of the North Pole or beyond eighty-four degrees north latitude.

The South Pole and Antarctic regions present a striking contrast, being surrounded by great oceans, with South Af-

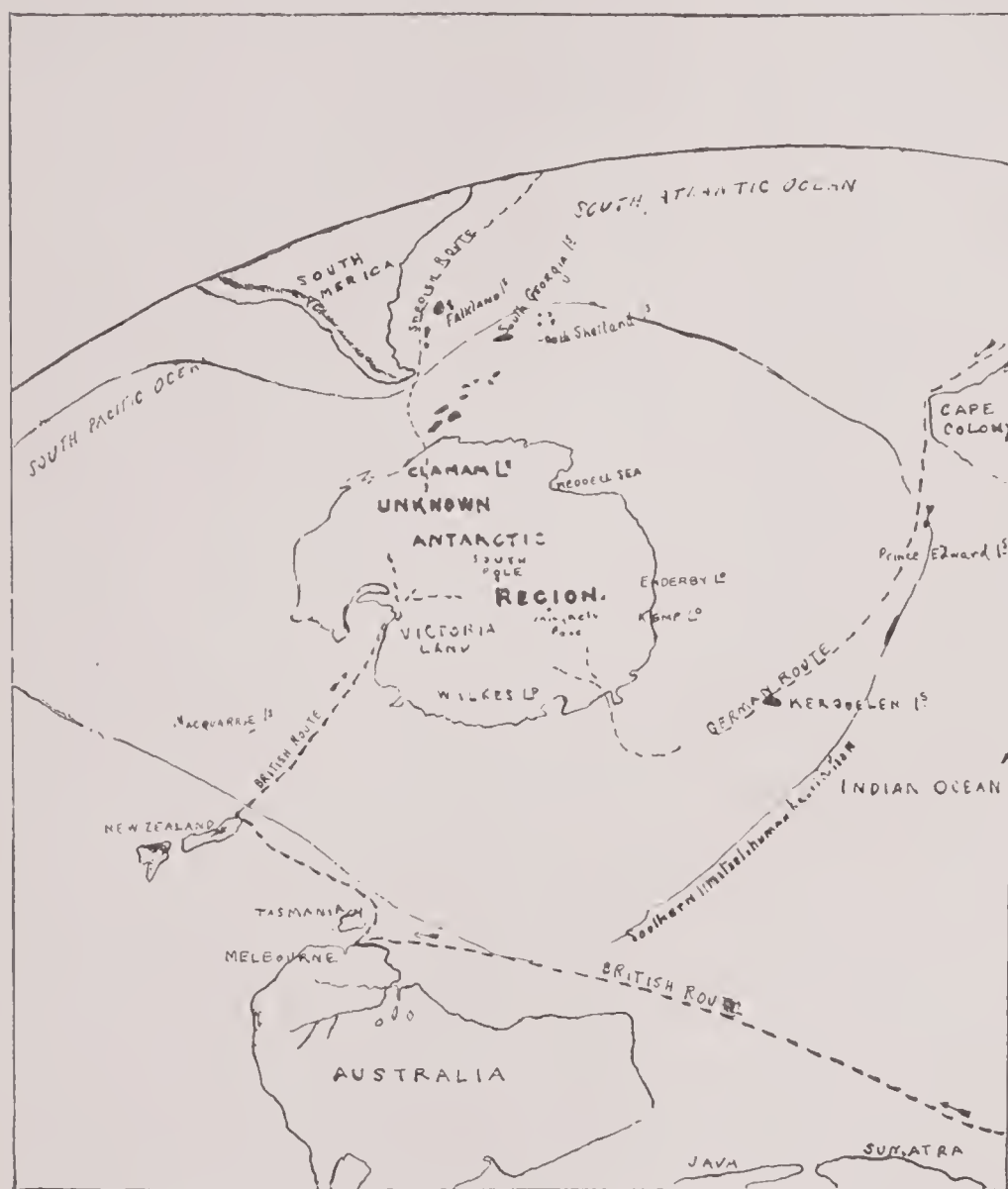
rica, South America, Tasmania and New Zealand, the nearest inhabited lands, long distances away. No plant life has been found south of sixty-four degrees south latitude, and the snow line descends to the water's edge in every land within the Antarctic circle. No quadruped has been

cessible. The advance of explorers has been stopped by ice barriers in every direction, from 300 miles to 500 miles more distant from the Pole than has been attained in the Arctic regions. Icebergs from the Arctic ocean are carried as far south as the fortieth parallel, but bergs and floes in

the Antarctic are found even in the summer ten or fifteen degrees nearer the equator. The Antarctic region as compared with the Arctic is remarkable for low temperatures. South of the sixty-second parallel the mean temperature of the sea and air is always below the freezing point of fresh water.

Few navigators have crossed the Antarctic circle, and fewer still have passed the seventieth parallel. Within the last few years, however, there has been a revival of interest in Antarctic exploration, and four distinct voyages have been made in the effort to penetrate the mysteries of that dreary sea of ice. One of these was under British auspices, one

was Swedish, and one was German. The course of these three is indicated on the accompanying sketch map, which gives a graphic idea of the world as it would look if we could see it from below. The other expedition, which was conducted by Bel-



BIRD'S-EYE VIEW OF THE SOUTH POLAR REGIONS.

Showing the southernmost inhabited lands, and the routes of recent exploring expeditions.

found south of sixty degrees south latitude, so that there is a belt outside of the Antarctic circle almost as wide as that within, which does not sustain animal life. The isolated islands discovered within the Antarctic regions are almost everywhere inac-

gian explorers, was the first in the point of time of all these recent voyages and is not indicated on the map herewith.

The famous predecessors of these most recent explorers were Captain Cook in 1772, Weddell in 1823, and Ross in 1841. The latter sighted a land with mountain ranges extending to a height of 15,000 feet, and traced the coast for 800 miles, naming it Victoria Land. He also discovered a great active volcano, 12,000 feet high and named it Mount Erebus. The islands which are named here in the far south are the South Shetlands, South Georgia, Victoria Land, Kerguelen island, Possession island, Alexander island and a few others even more obscure. The dangers of disaster in these explorations are great, and the hope of rescue in the event of calamity almost nothing. The rewards of possible success in the Antarctic do not promise to be as great as those in the event of success in the far north. The Antarctic is an uninhabited, ice-bound, perpetually frozen region, with nothing but the Aurora Australis and the active volcanoes to break the monotony, and no commercial reason to justify the loss of life and ships in the effort to win success.



MINES OF ICE IN ARIZONA

Nowhere in the world does there exist an industry more unique than that put in operation in 1902 in northern Arizona, where elaborate plans were laid to utilize the product of the ice caves in existence there. Strange it seems, too, that in this land of great heat, where in some places ice is a priceless luxury, made so by excessive freight rates which prevail in the territories, man's ingenuity has not before con-

ceived the idea of the wholesale appropriation of the relief which nature has provided.

Not until very recently has any attempt been made to take away the apparently inexhaustible quantities of ice which have been found in the caves near Flagstaff. Now, however, it is intended to literally mine or quarry the ice, and the promoters of the scheme declare it will prove a great profit producer from the very outset, as they expect to secure ice enough not only to supply the scores of smaller stations, towns and lumber camps in that vicinity, but to provide a supply for the railroads of northern Arizona and New Mexico, even into California, as in the vast region of what was once the northern part of the great American desert ice factories have not as yet become common. Indeed, the factories at Los Angeles, Phoenix, Albuquerque and Las Vegas have for years supplied most of that district with ice, although at prices that necessarily were prohibitive, made so by the long railway haul.

The main or best known ice cave lies at the head of Clark's Valley, seventeen miles southwest of Flagstaff. Although others may be larger, they are not so accessible. A wagon road leads nearly to the cave. The people of the country think the cave was originally what is termed a "blow-out"—that is, a volcano vent made by water or gas, during some convulsion of nature, in the early history of our planet. There are many of these "blow-outs" of various size and extent scattered over Arizona.

Until August, 1901, the main cave had only been penetrated to a depth of 200 feet, and even that distance could be reached only by the possessors of small bodies. At that time E. R. Dulton, a young man

from New York, succeeded in creeping and crawling through the narrow crevice at the 200-foot point and over 100 feet further he found the cavity gradually widening until it grew into a cavern much larger than that near the surface. He found several smaller caves leading out of the large one, all in almost solid ice, and he believes that they lead far into the earth.



LITTLE PLANETS IN OUR SOLAR SYSTEM

It is no surprising thing nowadays for the announcement to be made that another

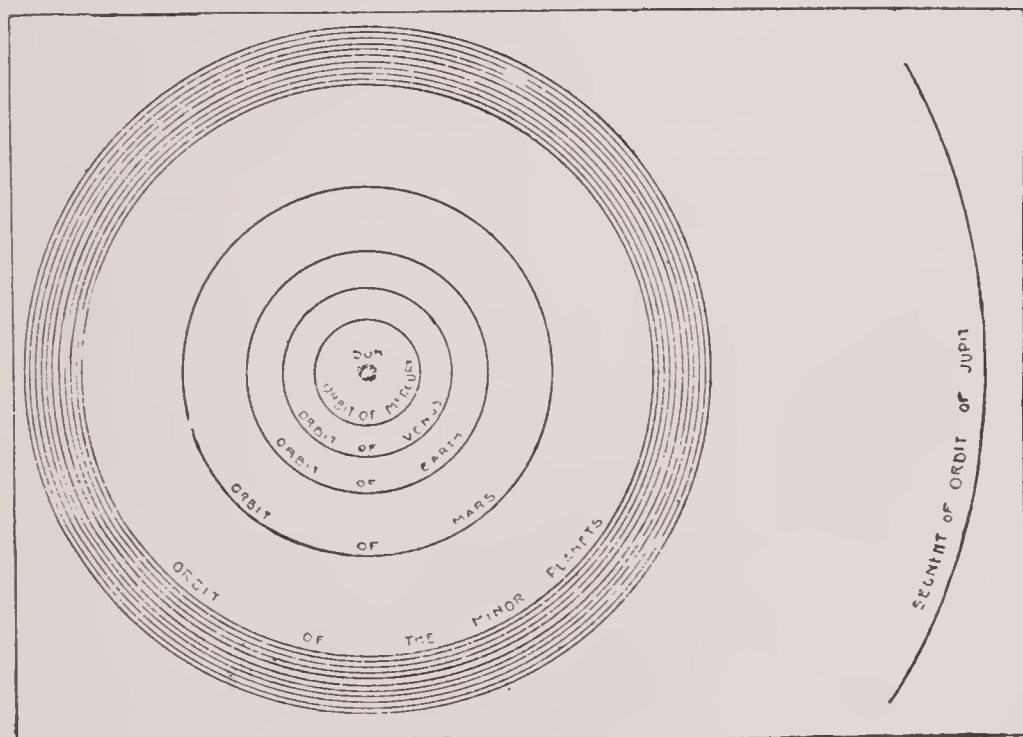
is less than seventeen miles. There are doubtless some even smaller—about large enough for a farmer's cornfield, perhaps.

So diminutive are these curious members of the solar system that even after one has been discovered it is quite likely to be lost. Of course it is possible to trace the movements of the asteroids as well as those of the larger planets, but the labor of doing so, especially of the many tiny ones of little practical interest, surpasses the probable value of the result, and in consequence the orbits of most of them are not yet calculated. The orbits of all these diminutive worlds lie in a belt about 100,000 miles wide and with a mean distance from the sun of about 250,000,000 miles.

At present more than 250 of these little worlds have been discovered, and more are found nearly every year. How many there may be it is impossible to estimate. One astronomer thinks there may be as many as 150,000 of them. The total number, whatever that may be, depends largely on whether or not there is any limit to their minuteness. If there is

no such limit, that is, if some are very much smaller than those now known, too small to be seen with the telescopes now in use, there may be an indefinite number.

Several theories have been advanced to account for the presence of the asteroids in that part of the solar system to which Bode's law assigned a planet long before



THE ORBITS OF THE MINOR PLANETS.

planet has been discovered. Time was, however, when such an announcement was received with much interest. It is well known that between the orbits of Mars and Jupiter there is a belt ring of tiny bodies, "pocket planets," as Herschel called them, none with a greater diameter than 200 miles, and some whose assigned diameter

their existence was known. Olbers proposed the hypothesis that they had once formed a single planet, which had at some remote time been shattered by a great explosion, the fragments continuing to revolve about the sun in approximately the orbit of the original planet.

The considerable variation in the eccentricity and inclination of their orbits, not to be accounted for by any present mode of calculation, and the greater probability of their separate formation just as were the other and larger planets according to the nebular hypothesis, has led to the general discarding of Olbers' theory.

None of the greater planets has orbits whose eccentricity much exceeds one-tenth the diameter or whose inclination to the ecliptic is greater than three degrees. Of many asteroids, however, the orbits are inclined more than ten degrees and have an eccentricity in excess of one-fourth the diameter.

According to the nebular hypothesis, which is at present generally accepted, the minor planets as well as the greater ones, were formed by the condensation of rings of cosmic matter surrounding the sun. In the case of the asteroids the ring instead of condensing into one mass condensed about many points, the result being a great number of pigmy planets instead of a single large one, as in the case of the others.

If all the minor planets now known were to be combined into one, its diameter would be less than 400 miles. A thousand more of them, supposing them of the average size, would make the globe scarcely a hundred miles greater in diameter, and its mass would even then be less than one four-thousandth of the earth's.

Assuming the density of these little

worlds to be approximately that of the earth, bodies on their surfaces would weigh very little. A man placed on one of them could easily jump to a height of sixty feet, and in a day he could walk entirely around his little world with less exertion than is required for his morning walk on this planet.

Though astronomers had from the time of Kepler believed a planet would be found with an orbit between those of Mars and Jupiter, the discovery of the first asteroid, Ceres, which is also one of the largest, was quite accidental. In the year 1800 an association of astronomers was formed for the express purpose of searching for the supposed planet, and each member was allotted a particular portion of the heavens, which he was to search carefully.

On January 1, the first day of the new century, Piazzi, an Italian astronomer, not a member of the society, and not particularly interested in its object, was searching for a star that had been, by the error of the printer, placed in Wollaston's catalogue. While looking for this star which did not exist he found another not previously known to be there. Examining it the next night, he found that it had changed its position and must therefore be a planet. When its orbit had been calculated it was found to be the planet sought. Considerable surprise was therefore occasioned when, two years later, another was found in the same region of the solar system, and still greater was the surprise as still others were found at intervals. Now the reported discovery of another planet attracts scarcely a passing notice. Scientists learn more about this world and the universe every day, and it is no longer well to be surprised about anything.

GREAT CAVES OF THE WORLD

It will be long before the wonders of nature are all revealed to man, for in addition to those which tempt travelers to remote and almost inaccessible parts of the world, there are others continually being discovered beneath the surface of the earth. Caverns have always had a mysterious interest wherever discovered. Their dark-

rock. Those which are found inland, among the mountain ranges or elsewhere, come in like fashion from the percolation of water from the rocks above, and the gradual chemical processes that take place.

The most famous cavern of the former class is the Blue Grotto of Capri. This is found in the island of Capri in the Mediterranean Sea, not far from Naples. It can be reached only when the water is com-

paratively calm, by small boats which follow around the rocky coast and pass directly into the grotto under an arch which spans the channel. Once within, a succession of vaulted arches forms the roof of the grotto, which extends for a considerable distance into the island. Of course the sea within is calm, except when storms outside send their waves through the arched entrance and make the passage im-



BLUE GROTTO OF CAPRI, ITALY.

ness, the unknown depths to which they may lead, the dangers of exploration in them, all appeal strongly to the seeker after the marvelous. They are almost always the result of the action of water. Those upon the seashore are hollowed out by the action of the waves, either by means of the constant battering of the surf, or the dissolving of some of the elements in the

possible. The rocks which form the roof are of a peculiarly beautiful blue in color and covered with glittering crystals. The light which passes through the entrance and reflects from the surface of the water seems to be multiplied many times, and gives the grotto a striking beauty. When artificial lights are used at night or to heighten the effect by day, the color effects are mag-

nificent and the fame of the grotto is well justified.

The largest cavern commonly visited and conveniently open to tourists, if not the largest in the world, is Mammoth Cave in Kentucky. Two hundred miles of avenues, passages and vaulted chambers are opened to visitors and it is well known that the cave is by no means fully explored. From a descriptive sketch by Dr. R. Ellsworth Call, a careful student of the Mammoth Cave and its conditions, the following facts of interest have been selected:

Mammoth Cave owes its discovery to an accident, so the story goes, which happened in the year 1809. It is the old story of a hunter and a bear, the pursuer and the pursued. The bear was wounded and sought its lair in a vain endeavor to escape. Hutchins, for such was the hunter's name, lost no time in acquainting others with this important discovery, and Mammoth Cave became both a fact of history and science. It is strange to relate that its first exploitation was connected with simply mercenary motives and that saltpeter intended for use in gunpowder, and connected with the War of 1812, was the incentive that led to more complete examination. The men who mined the salt soil, rich in niter, are the men who first gave to the outside world any reliable information of the great extent of this now famous world's wonder.

Within the cavern the changes which have occurred since the days of saltpeter are few. There is only that change which comes from wider acquaintance with the windings of the chambers into those that are new and formerly unknown, a change which makes the visitor despair of ever

fully unraveling all the passages and crevices along which he journeys or through which he crawls. Bridges over rivers and stairs leading up impassable cliffs, the iron guards along places of danger, alone tell the visitor of the work of man.

It is impossible to mention all the objects of interest to visitors in this most gigantic cavern. The Fairy Grotto, the Gothic Avenue, Martha's Vineyard, Crystal Avenue, Echo River, Gorin's Dome, the Giant's Coffin, the Corkscrew, the Standing Rocks, the Rotunda, Audubon's Avenue, Spark's Bower, Lover's Leap, the Ruins of Karnak, Shelby's Dome, and a multitude of other special sights are shown to every visitor.

The Echo River is one of the most remarkable features in this most remarkable group of wonders. Only a small portion of its whole course is accessible to visitors, but this part is truly wonderful. At times the river flows with almost imperceptible current, while at other times it fills quite to the top the great River Hall, blotting out the Dead Sea and the River Styx, both of which are really parts of the underground stream. It is traversed by boats for a distance of half a mile, and the ride over its clear waters is one of the unique experiences of the world. Nowhere else can it be duplicated. The voyager passes under a low arch for a short space, and then the roof rises rapidly away from the water and he enters upon his subterranean water journey in real fact. Nearly all the river is one vast resonator. Its branching avenues and side crevices, its lofty roof of limestone rock, its ancient battlemented shores, all serve as reflectors of every sound, no matter how slight, and send it back intensified a thousand times, with its

roughness blended into one sweet volume of glorious harmony.

Perhaps visitors to Mammoth Cave are most impressed with the lofty domes and deep pits which are found in some portions of this underground domain. Of those that are accessible to the visitor without great danger and fatigue, the best known



THE BOTTOMLESS PIT, MAMMOTH CAVE.

are Gorin's Dome, the Bottomless Pit, Mammoth Dome, Napoleon's Dome, the Maelstrom and Scylla and Charybdis, all but two of which are situated in that intricate and wonderful portion called the Labyrinth. The first named is viewed through a natural circular opening in the wall, quite three-fourths of the way from

the bottom. Illuminated by the guide from a point still above that at which the visitor is situated, the effect through the brilliant lights on the walls beyond, white as alabaster, folded in a thousand curious and fantastic forms, is indescribably grand and impressive. Coupled with the great size of the space, everywhere shading off into infinite gloom, is the roar of falling water or the splash of Lilliputian cascades if seen in the dry season. Below, but beyond observation, is a portion of Echo River into which from a station high above it is possible to throw stones, the fall of which awakens ten thousand sounds and echoes. Stalactite matter of purest white, lends a variety to the vertical walls. Not far away is the Bottomless Pit, and above it, rising sheer to the topmost level of the cavern, is Shelby's Dome. Its bottom, for notwithstanding its name it has one, is nearly two hundred feet below the level at which the observer stands.

Of all the pits which the visitor sees, that called Mammoth Dome is the largest and most impressive. From the top to the bottom the distance is nearly 280 feet, while at the end the Ruins of Karnak stand out in bold relief. These giant columns closely resemble the works of art of some long lost underground race.

Far from the Mammoth Cave of Kentucky, in the Black Hills of South Dakota, is another great cavern called the Wind Cave, which was discovered in 1877. Three thousand rooms have been discovered in it, varying in size from an ordinary bedroom to more than three acres, and over a hundred miles of passages have been explored

without finding the end. Out of fourteen different routes, three have been opened to the public. Its geological formation is a puzzle to the student, as the formations have no parallel in other well-known caves, and seem to upset many well-established theories. Another mystery is the fact that at times the wind blows into the cave at the mouth and at other times blows out, but when blowing a gale it is felt only at the entrance.

Other caverns, large and small, have been discovered in the United States, including some of great interest in Colorado, and others in New Mexico. This country is not unique in such works of nature, but we seem to have by far the largest and most beautiful of all, and Mammoth Cave is by all means the most famous and the most commonly visited.



THE LAND OF THE MIDNIGHT SUN

The entire Arctic and Antarctic regions may be properly called the "Land of the Midnight Sun," for at the poles darkness rules for six months in the year, and just within the Arctic and Antarctic circles the sun may actually be seen at midnight. In practice, however, the north coast of Norway has become known by this phrase, for it is the most accessible place where the striking and picturesque phenomenon of sunshine at midnight can be seen. To reach the polar region elsewhere means a genuine Arctic voyage, attractive enough for the explorer, but quite out of the question for the casual tourist. To see the midnight sun off the coast of Norway, however, it is necessary only to buy a ticket and

board one of the fine vessels, built like great yachts, which make a voyage to the North Cape and beyond every summer, from various European ports. The entire coast of Norway, skirted during these voyages, is characterized by bold and beautiful scenery, with great cliffs, deep inlets or fjords, and mammoth glaciers. Waterfalls tumble from the heights above, and the life of the people in the little Norwegian villages is no less picturesque than the natural beauties of the region.

Hammerfest, the most northern town of Europe, is the metropolis of the Arctic regions, and the port from which many polar exploring expeditions have taken their departure from civilization. During the two summer months, the sun remains continually above the horizon and the climate becomes very warm. Even in the winter, when darkness rules for two months, the weather is mild enough to permit the fisheries to be carried on as usual.

Then comes the North Cape, the extremest point in Europe, looking out over the Arctic Ocean. It is a dark, gray, slate rock, furrowed with deep clefts, rising nearly 1,000 feet abruptly from the sea. The traveler lands on the east side of the Cape, where a path has been constructed over the green, mossy slope to the top. Here the hour of midnight is awaited, when the northern sun, creeping along the horizon, and the immeasurable ocean in apparent contact with the skies, form the grand outlines in the sublime picture presented. With the North Cape ends the island belt, and the coast is washed directly by the sweeping waves of the Arctic Ocean. Beyond is the region of mystery, which is gradually being penetrated year after year, a few miles at a time, by those

persevering explorers who are seeking the pole.

Says an appreciative writer, speaking of conditions in this far-northern region: "The polar night in the highest latitudes begins in October and lasts until nearly February. Then the sun appears each day, at first for a moment only, and then longer and longer, till by May it does not set at all. For three months there is perpetual

living has been making preparation for this. The sea animals, except the few hardy enough to brave the ice-covered depths, have departed. The birds and many land animals have moved southward, where food and shelter are surer. The people, all Eskimos, have given up their seal huts in the extreme north, and have built their winter huts out of ice blocks in some favored nook, or contiguous to some well-



THE MIDNIGHT SUN, OFF THE NORTH COAST OF NORWAY.

day. For three months more the days rapidly shorten. By the time October is past, darkness is on again and the Pole is wrapped in long night and inclement winter. Nature then takes on its fantastic ice forms. Freezing is sudden and persistent. Storms are violent and of long duration. The seas are ice-bound, the rivulets locked in silence, the land covered with an immense depth of snow. Everything

known resort of the seal or walrus. In these they doze away their tedious winter existence, warmed and lighted by lamps burning fat, and fed by blubber, which is mostly eaten raw. If they open for a moment a window or doorway, the confined air of their huts is immediately precipitated in the form of a shower of snow.

"When the sun reappears, to shine perpetually for the summer months, the

change is great. Weak as its rays are, they constantly serve to break up the strongest ice fields and loosen the stoniest packs. There is a commotion in the frozen seas more dangerous than a tempest. The ice groans and labors. It cracks with thunderous reports. Huge mountains topple and fall. And then, when fields and floes are sufficiently broken to obey the currents, whole areas, large as a state, float away, bearing unlucky ships or whatever they may have imprisoned. By the end of June the ice of the Arctic sea is commonly divided and scattered. Then there is excessive moisture everywhere, and thick fogs hang over land and water, almost incessantly. But in July the water no longer chills the atmosphere and precipitates moisture. It is a bright month and in sheltered spots the heat may become excessive. This heat, together with the absence of man and the loneliness of nature, is taken advantage of by myriads of animals from the air, land and sea. They congregate in the cliffs to lay eggs and hatch broods, gather in quiet nooks to bring forth their young, or swarm in shoal waters to spawn.

"Do not expect to find much verdure in the Arctic region. Even before you enter the Arctic circle you will notice that trees have been getting smaller in size, and that only the hardier ones, as the birches and pines, exist at all. Passing on, the trees disappear entirely except in sheltered spots. About the Pole is an immense zone destitute of all trees. The only vegetation consists of lichens, mosses and a few varieties of stunted grasses, with here and there, in protected places, a trailing plant or two. Though nature generally wears a more stern and forbidding aspect on advancing

toward the Pole, yet these high latitudes have many beauties of their own. Nothing can exceed the beauties of an Arctic sunset, clothing the snow-clad mountains, fantastic ice shapes and clear skies with all the glories of color, nor can anything be more serenely beautiful than the clear, starlit night, illuminated by the moon, which is seen like a shield of burnished silver through the highly rarefied air, and circles for days around the horizon, never setting until she has run her long course of brightness.

"But of all the magnificent spectacles that relieve the gloom of the Arctic winter, there is none so gorgeously resplendent as the *Aurora Borealis*. It bursts with the suddenness of a storm, as indeed it is an electrical storm, upon the northern horizon, and speeds to the zenith in a great arch of flame, heaving and waving to and fro, sending out flashing beams, playing the tricks of meteors in color and velocity. Then there is a gathering of splendors in the center of the magnificent arch. The brilliancy of the meteoric streams grows more intense. The red color of their base, the green of their middle, the yellow of their tips become deeper and more vivid. They dart with greater vivacity through the skies; the earth itself is clothed with a magical light; the sea, where unfrozen, and the ice fields, gleam with a strange and weird beauty. Heaven and earth tremble in their outlines as if all were unreal, and night hides the charm of the spectacle by her imposing silence. Gradually the crown fades, the brilliant bow dissolves, the streams shorten, the meteoric play is less vivid and frequent, the storm subsides, and the gloom of winter succeeds the midnight magnificence."

NIAGARA FALLS

The tremendous cataract of Niagara Falls, with the wonderful rapids above and below, has been recognized for centuries as one of the greatest natural wonders of the world. From the time of the first discovery by Europeans until to-day, Niagara has been sought by travelers who thought themselves well repaid for a journey of any length when they stood for their first view of the Falls, upon the verge of the precipices that look upon it.

The earliest account which we have of the Falls was written by the missionary priest, Father Louis Hennepin, and printed in his "New Discovery" in 1697. It would be difficult to find a more picturesque traveler's tale than the good priest told as it is quoted herewith, and he may be pardoned his extravagances when we remember that he had never seen anything of the sort before.

"Betwixt the lakes of Ontario and Erie, there is a vast and prodigious cadence of water, which falls down after a surprising and astounding manner; insomuch that the universe does not afford its parallel. 'Tis true, Italy and Suedland boast of some such things, but we may well say they are but sorry patterns when compared with this of which we now speak. At the foot of this horrible precipice we meet with the river Niagara, which is not above a quarter of a league broad, but is wonderfully deep in some places. It is so rapid above this descent that it violently hurries down the wild beasts while endeavoring to pass it to feed on the other side, they not being able to withstand the force of its current, which inevitably casts them headlong, above six hundred feet high. This wonderful down-

fall is compounded of two great cross streams of water and two falls, with an isle sloping along the middle of it. The waters which fall from this horrible precipice do foam and boil after the most hideous manner imaginable, making an outrageous noise, more terrible than that of thunder, for when the wind blows out of the south, their dismal roaring may be heard more than fifteen leagues off."

Since Father Hennepin's time, multitudes of poets, artists and prose writers have painted with word or brush the glories of Niagara, and millions have visited it. In the space here at command, it would be a fruitless effort to attempt a description which would be satisfactory either to writer or reader. This American wonder, so stupendous, so beautiful and so accessible, should be visited by all. The curve of the gigantic Horseshoe, the green wooded islands, the ponderous curtain of the American Fall, the gorges, the rapids, the whirlpool and the surroundings offer inexhaustible scenes of marvelous beauty and of great variety.

The wide-traveled, judicial-minded and discriminating Anthony Trollope penned the deliberate opinion: "Of all the sights on this earth of ours which tourists travel to see, I am inclined to give the palm to the Falls of Niagara. In the catalogue of such sights, I intend to include all beauties of nature prepared by the Creator for the delight of His creatures. I know of no other one thing so beautiful, so glorious, and so powerful. At Niagara there is that fall of waters alone. But that fall is more graceful than Giotto's Tower, more noble than the Apollo. The peaks of the Alps are not so astounding in their solitude. The valleys of the Blue Mountains in Jamaica are



(By courtesy of the Michigan Central Railroad.)

NIAGARA FALLS, THE WORLD-FAMED CATARACT.

Showing the American Fall, Goat Island and the Horseshoe Fall from Prospect Point.

less green. The finished glaze of life in Paris is less invariable, and the full tide of trade round the Bank of England is not so inexorably powerful."



WONDERS OF THE DEEP SEA

The time may come when there will be no portion of the earth's surface that has not been surveyed and explored by man. The work of enterprising travelers has now been carried on within a measurable distance of the North Pole; the highest mountain ranges are gradually succumbing to the geological surveyor; the heart of Africa is giving up to us its secrets and its treasures, and all the desert places of the earth are being visited. The bottom of the deep sea was until quite recently one of these unknown lands. It was regarded by most persons as one of those regions about which we do not know anything, and never shall know anything, and do not want to know anything.

But the men of science fifty years ago were not disposed to take this view of the matter. Pushing their inquiries as to the character of the sea fauna into deeper and deeper water, they at length demanded information as to the existence of forms of life in the greatest depths. Since that time, by the aid of various government appropriations and scientific expeditions, a large amount of information has been placed at our command about this most interesting region.

Hardly more than fifty years ago, the methods of deep sea investigation were so imperfect that naturalists believed life to be practically non-existent in the abysses of the great ocean. Various navigators and scientists, prior to that time, had recorded

isolated discoveries of strange creatures, brought up from the depths of the sea on their sounding lines, but the facts were not scientifically classified, nor do they contribute much to the knowledge of ocean depths. Americans were pioneers in these investigations, and in 1853 two officers of the American Coast Survey made one of the most important discoveries of an inhabited region at the bottom of the sea. In 1860 the doctor on board a British man-of-war collected thirteen star-fish from a depth of 1,260 fathoms. The Norwegians and the Swedes, likewise, became active about the same time.

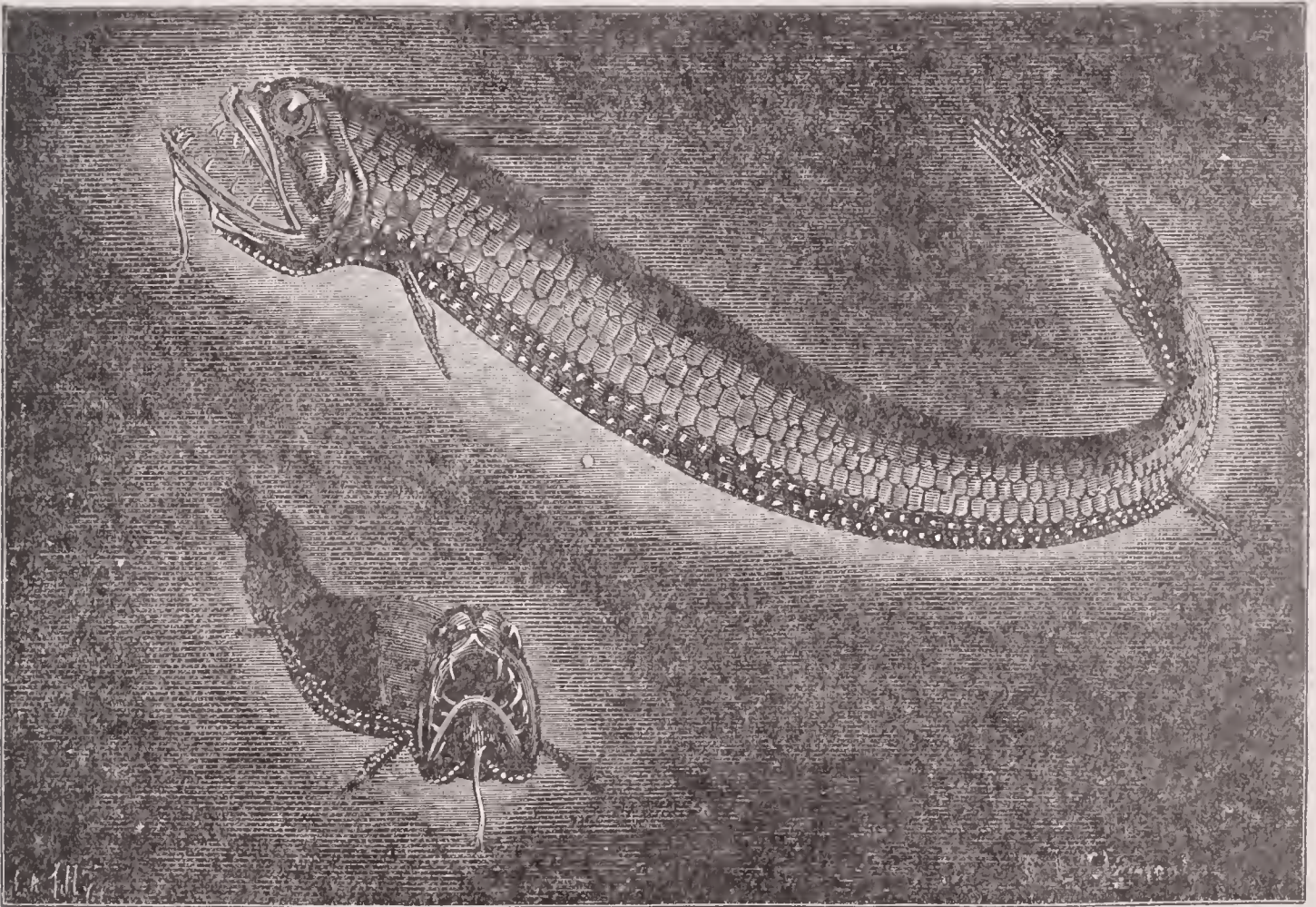
The physical conditions of the abyss of the great oceans are such that it is not surprising that the naturalists of the early part of the last century could not believe in the existence of life at the bottom of the deep sea. The extraordinary conditions of such a region, the enormous pressure, the absolute darkness, the probable absence of any vegetable life from want of direct sunlight, might very well have been considered sufficient to form an impassable barrier to animals migrating from the shallow waters, and to prevent the development of a fauna, peculiarly its own. The peculiar physical conditions of the deep sea may be briefly stated to be these: It is absolutely dark, so far as actual sunlight is concerned; the temperature is only a few degrees above the freezing point; the pressure is enormous; there is little or no movement of the water; the bottom is composed of a uniform fine, soft mud, and there is no plant life.

At a depth of 2,500 fathoms, the pressure is, roughly speaking, two and one-half tons per square inch, that is to say, several times greater than the pressure exerted by

the steam upon the piston of our most powerful engine, or, to put the matter in other words, the pressure per square inch upon the body of every animal that lives at the bottom of the Atlantic ocean is about twenty-five times greater than the pressure that will drive a railway train.

It is but reasonable to suppose that the ability to sustain this enormous pressure can be acquired by animals only after gen-

plunged into very deep water. The fish that live at these enormous depths are in consequence of the enormous pressure liable to a curious form of accident. If in chasing their prey or for any other reason they rise to a considerable distance above the floor of the ocean, the gases of their swimming bladder become considerably expanded and their specific gravity very greatly reduced. Up to a certain limit the



STOMIAS BOA. HALF NATURAL SIZE. FROM A DEPTH OF A MILE AND A QUARTER.

erations of gradual migrations from the silent shallow water. Those forms that are brought up by the dredges are usually killed and distorted by the enormous and rapid diminution of pressure in their journey to the surface and it is probable that shallow water forms would be similarly killed and crushed out of shape were they suddenly

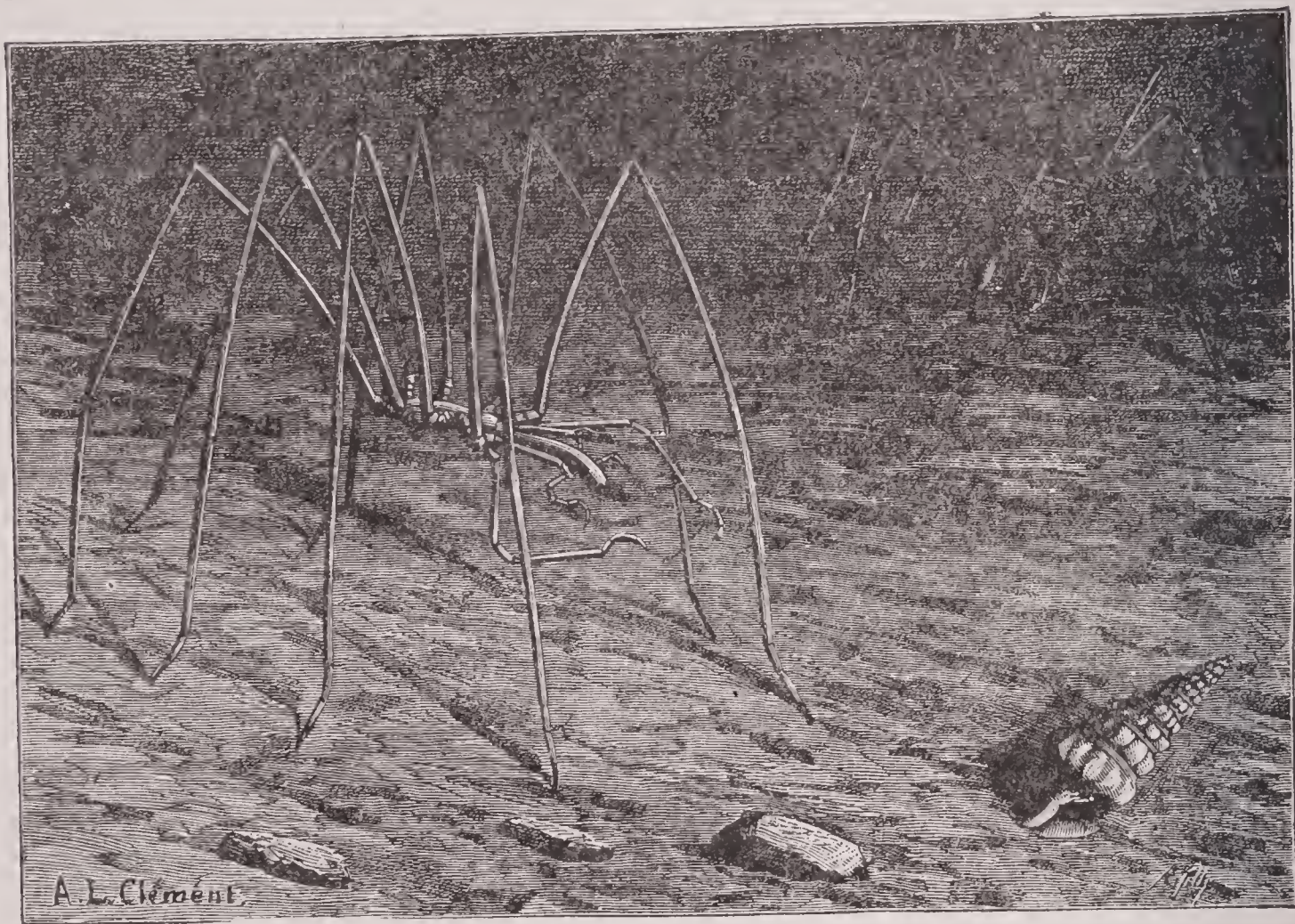
muscles of their bodies can counteract the tendency to float upwards, and enable the fish to regain its proper sphere of life at the bottom. But beyond that limit the muscles are not strong enough to drive the body downward and the fish becoming more and more buoyant as it goes, is gradually killed on its long and involuntary

journey to the surface of the sea. The deep sea fish then are exposed to a danger to which no other animals in this world are subject, namely, that of tumbling upwards.

The most recent experiments that have been made tend to show that no sunlight whatever penetrates to a greater depth than half a mile. But although it is highly probable that not a glimmer of sunlight ever penetrates to the depths of the ocean, there

globe according to the depth and the proximity of land and the presence of the neighboring volcanoes or the mouths of great rivers.

It has not been determined yet with any degree of accuracy where we are to place the limit of vegetable life, but it seems probable that below a hundred fathoms no organisms excepting a few parasites are to be found that can be included in the veg-



COLLOSENDEIS ARCUATUS, FROM A DEPTH OF ONE MILE.

is in some places a very considerable illumination, due to the phosphorescence of the inhabitants of the deep water.

The floor of the ocean, if it were laid bare, would probably present a vast, undulating plain of fine mud. Not a rock, not even a stone, would be visible for miles. The mud varies in different parts of the

etale kingdom. All plants except a few are dependent upon the influence of direct sunlight and since sunlight cannot penetrate more than a few hundred fathoms of sea water, it is impossible for the plants to live below that depth. The absence of vegetable life is an important point, for it is in consequence necessary to bear in mind

that the food of deep sea animals must be derived from the surface. It is possible that the creatures of the deep sea in some cases feed upon one another, but the fauna would soon become exhausted if it had no other sources of food supply. This other source of supply is derived from the bodies of organisms that fall from the upper waters of the ocean.

Now let us note briefly a few points of interest about the creatures themselves that have been found. The different oceans and different depths, roughly speaking, show distinct characteristics in the life found therein, as truly as do the different continents of the world. So the scientists have marked out the different zones and localities on it. Strangely enough the creatures of the deep sea vary in color to a very remarkable extent. Shades of red occur rather more frequently than they do in the fauna of any other zone or region and there are no blue animals known to live in deep water, while green, also, is extremely rare in the greatest depths. The eyes of the animals that live in deep sea water undergo curious modifications. In the majority of cases, we find that the eyes are either very large or very small. In depths of 300 to 600 fathoms the majority are large eyed forms. This is as we should expect, for it is more than probable that many of these forms occasionally wander into the shallower waters where there is a certain amount of sunlight. In depths of over one mile, the small eyed and blind forms are in the majority, although many large eyed forms are to be found.

In these abysmal depths are found representatives of all the great classes of marine life which are recognized, from the true fish, which are of the highest order, through

crustaceans, mollusks and seaworms to the lowest forms of protozoa, coelentera and echinoderma. The species are not large in comparison with those known to us in shallower depths, but range in size from minute forms to some which measure eight or ten inches in length. It may be a little puzzling to understand exactly what profit can come from costly investigations of these abysmal depths, and the answer must be found in the broad generalization that all knowledge is valuable, and the more we know about this world of ours the better. No land has yet been found where life does not exist, and the most profound depths of the sea, miles below the surface, are likewise found to be teeming with life. Nature's wonders are everywhere, and the true scientist desires to learn of the most obscure and the most remote things as truly as of those which are near and obvious.



EXTINCT MONSTERS

Menageries and zoölogical gardens have given to every one a pretty fair idea of the characteristics of animal life to-day. These are supplemented by a wealth of fine pictures which make the rarest creatures familiar enough in appearance. But there were wonderful creatures here in this earth before man was created, and but few of them are known by name or appearance to the average reader of to-day. And yet the actual appearance and habits of life of these extinct monsters which lived thousands of years ago can be conceived with some accuracy, thanks to the studies of learned men who have searched deep in the science of comparative anatomy. Various technical works exist upon this subject, and at least one popular account of the forms

of ancient animal life. From the latter, by the Rev. H. N. Hutchinson, the following interesting facts are summarized.

Let us remember that it is not mere imagination that guides the man of science in such matters, for all his conclusions are intended to be based on reason. For millions of years countless multitudes of living animals have played their little parts on the earth and passed away, to be buried in the

Down in those old seas and lakes she kept her great museum in order to preserve for us a selection of her treasures. In the course of time she slowly raised up sea beds and lake bottoms to make them into dried land. This museum is everywhere around us. We have but to enter stone quarries and railway cuttings, or to search in coal mines or under cliffs at the seaside, and we can consult her records.



A GIGANTIC ARMORED DINOSAUR. LENGTH, ABOUT THIRTY FEET.

oozy beds of the seas of old times or entombed with the leaves that sank in the waters of primeval lakes. The majority of these perished beyond all recovery, leaving not a trace behind. Yet a vast number of fossilized remains have been in various ways preserved, sometimes almost as completely as if Dame Nature had thoughtfully embalmed them for our instruction and delight.

It is to Cuvier that the world owes the first systematic application of the science of comparative anatomy and palæontology, as the science is called which treats of the living beings, animal, or vegetable, which have inhabited this globe at past periods in its history. He paid great attention to the relative shapes of animals, and the different developments of the same kind of bones in the various animals and especially

to the nature of their teeth. So great did his experience and knowledge become that he rarely failed in the naming of an animal from a part of its skeleton. He appreciated more clearly than others before him the mutual dependence of the different parts of an animal's organization. "The organism," he said, "forms a connected unity in which the single parts cannot change without modifications in the other parts."

As he progressed in these studies, Cuvier was able with considerable success to restore extinct animals from their fossilized remains, to discover their habits and manner of life, and to point out their nearest living allies. To him we owe the first complete demonstration of the possibility of restoring an extinct animal. His "law of correlations," however, has been found to be not infallible, but like other laws having its exceptions. To take one out of many examples of this law: carnivorous animals, such as cats, lions and tigers, have claws in their feet, very different from the hoofs of an ox, which is herbivorous, while the teeth of the former group are very different from those of the latter. Thus the teeth and limbs have a certain definite relation to each other, or in other words are correlated. Again, horned quadrupeds are all graminivorous (grain-eating) and have hoofs to their feet. The following anecdote serves to illustrate Cuvier's law. One of his students thought he would try to frighten the master, and having dressed up as a wild beast, entered Cuvier's bedroom by night and presenting himself by his bedside, said, in hollow tones: "Cuvier, Cuvier, I have come to eat you." The great naturalist, who, on waking up was able to discern something with horns and

hoofs, simply remarked: "What! Horns—Hoofs! Graminivorous. You can't."

It is impossible to describe in detail all of the greater extinct monsters which inhabited the earth, the ocean or the air, and thousands of smaller creatures are well-known and identified in museums which cannot even be suggested here. All we can do is to speak briefly of a few of the most interesting or peculiar. For instance, on the coast of Great Britain there lived sea scorpions, possessing a coat of armor, jointed bodies and limbs for crawling, swimming or seizing their prey. They were distant cousins of the crustaceans of the present day, lobsters, crabs and shrimps, but they measured at least six feet in length.

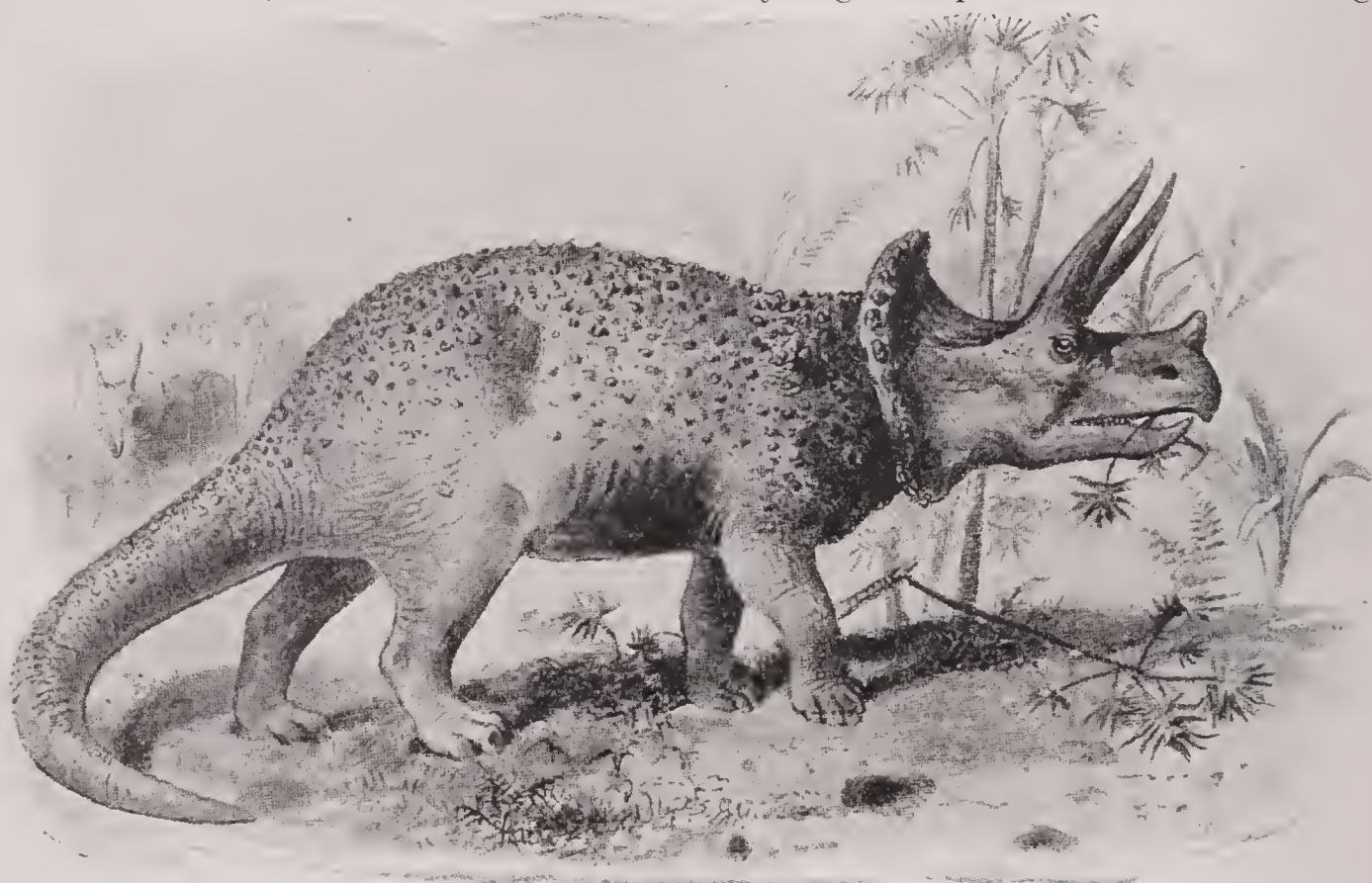
In the same waters, and about the same time, dwelt the old fish lizard or ichthyosaurus. Cuvier, describing it, said of this creature that it possessed the snout of a dolphin, the teeth of a crocodile, the head and breast bone of a lizard, the paddles of a whale or dolphin, and the vertebrae of a fish. It was a powerful monster, swimming rapidly enough to catch the fish upon which it lived. The long and pointed jaws were a striking feature of these animals, and their eyes were very powerful and large. The largest entire skeleton preserved in a museum measures twenty-two feet long, and eight feet across the expanded paddles, but from detached heads and parts of skeletons it is probable that some of them were between thirty and forty feet long. Then there were long necked sea-lizards known as the plesiosaurus, which, to the head of a lizard united the teeth of a crocodile, a neck of enormous length, resembling the body of a serpent, a tail and body having the proportions of

an ordinary quadruped, and the paddles of a whale. These also grew to a length of more than twenty-two feet. More than twenty species of these long necked sea-lizards are known to geologists.

Was there ever an age of dragons? Tradition says there was, but there is every reason to believe that the fierce and blood-thirsty creatures, of which such a variety present themselves, are but creatures of the

an order comprising the largest reptiles that ever lived; and while some of them in a general way resemble crocodiles, others show in the bony structures they have left behind a very remarkable and interesting resemblance to birds of the ostrich tribe.

Their remains are found not only in Europe, but in Africa. India, America and even in Australia. The geologist finds that they reigned supreme on the earth through-



A GIGANTIC HORNED DINOSAUR. LENGTH, ABOUT TWENTY-FIVE FEET.

imagination based, no doubt, on the huge uncouth reptiles of the present human era, such as crocodiles and other creatures. Nevertheless in spite of all manifest absurdities of the dragons of various nations and times, geology reveals to us that there once lived upon this earth reptiles so great and uncouth that we can think of no other but the time honored word "dragon" to convey the slightest idea of their monstrous forms and characters. The dinosaur was

out the whole of the great mesozoic era. Their bodies were in some cases defended by a formidable coat of armor, consisting of bony plates and spines, thus giving them a decidedly dragon-like appearance. They all had four limbs and in many cases the hind pair were very large compared to the fore limbs. The largest of the family were truly colossal in size, far excelling the rhinoceros and elephant of to-day.

One division of this family was the

brontosaurus, a vegetable feeding lizard. It was nearly sixty feet long and probably, when alive, weighed more than twenty tons. Each track made by the creature in walking occupied one square yard in extent. Its remains are found in the jurassic rocks in Colorado. Another member of the dinosaur family, the atlantasaurus, must have obtained a length of over eighty feet, and assuming that it walked upon its

about like bats and flying foxes do now. The scientists called them pterodactyls, but they may very properly be termed "flying dragons." Some were no larger than small birds, but the largest had a spread of wing, or rather of the flying membranes, of twenty-five feet. Imagine a flock of these hovering over an antediluvian landscape, in which the animal life below them was supplied by eighty-foot dinosaurs and sea



GROUP OF SMALL FLYING DRAGONS OR PTERODACTYLS.

hind feet, a height of thirty feet. A thigh bone of one of these has been found entire, and it measures six feet and two inches in length. Colorado has yielded large numbers of most interesting fossils of this variety. Some of them were carnivorous, and some were diminutive creatures only two feet in length.

In addition to the dinosaurs or land dragons, there was another great order of reptiles that acquired the power of flying

scorpions six feet long. Skeletons of sea serpents to a length of eighty feet have been found in the fossil deposits of Kansas.

Now we come to the great mammals of the past, animals not entirely unlike some that we know now, although immensely larger. America has been one of the most fruitful sources of information concerning these great creatures. In Wyoming have been found skeletons of a great animal called the tinoceras, which was akin to the

rhinoceros, the elephant, the hippopotamus, and which measured about twelve feet in length without the tail. Its weight, when alive, is calculated to have been three tons. Great numbers of bones of these creatures have been found. Another equally picturesque creature found east of the Rocky Mountains was the brontops, still larger, with toes instead of elephant-like feet.

India, too, has yielded some strange

creatures of the past whose names are most familiar to us, because they have come into the language and because they are not so long extinct as some of the strange creatures heretofore described. Approximately whole specimens of these primeval elephants have been found in the frozen regions of Siberia, preserved in the ice. The mammoth, indeed, has been actually seen in the flesh, and not only seen but



A GIGANTIC ARMADILLO, FROM BUENOS AYRES. LENGTH, NINE FEET.

monsters, including huge ones not unlike the moose of to-day, and a gigantic tortoise found complete as a fossil. From South America we obtain remains of gigantic mammals allied to sloths, ant-eaters and armadillos. The length of the best preserved specimen of these sloths is eighteen feet. The gigantic representative of the armadillo from South America is a huge armored creature more than eight feet long.

The mammoth and the mastodon are the

eaten both by men and animals, although the meat had been frozen perhaps for several centuries. Fossils, remains of these elephants, have been found in Europe, Africa, Asia and North America. There is to-day a large trade in the ivory of the mammoth from Siberia, both eastward to China and westward to Europe. Various islands along the Siberian coast yield the huge tusks in great number. The most perfect specimen exists in the museum of

the St. Petersburg Academy, the skeleton complete all except one leg, the skin still attached to the head and feet, and a large quantity of the hair remaining. This mammoth was discovered frozen in 1801 on the north coast of Siberia, and after several years was brought to St. Petersburg and mounted there. It had come to light by the thawing of a great block of ice which had covered it, and the people of the neighborhood had cut off the flesh and fed their dogs with it for two years before it was finally protected in the interest of science, and brought to Europe. There are at least nine cases on record of the discovery of frozen mammoths in northern Siberia, and it is not likely that the huge animal is long extinct.

The mastodon was similar to the mammoth, but probably preceded it in time. There is reason to think that in America it was contemporary with man in the prehistoric age. Numbers of partial specimens have been found in Kentucky, Ohio, Missouri, and other parts of the United States.

Of all the monsters that ever lived on the face of the earth, the giant birds were perhaps the most grotesque. New Zealand contributes the giant moa, a bird which stood twelve feet in height. The natives who were living at the time of the first white settlement of New Zealand, about 1840, declared the bird to be still in existence, but it cannot be learned that any white man actually saw the living creatures, although a search was made for them. However, fragments of shell and feathers were found with the bones of the birds, so that it is quite certain they had not been long extinct. In 1882 the head, neck, two legs and feet of a moa were found in a

cave, having the skin still preserved in a dried state covering the bones, and some few feathers of a reddish hue still attached to the leg. In the island of Madagascar, also, the remains of a giant bird and its eggs have been found. One of the eggs had a diameter of fourteen inches, and would contain more than two gallons, or as much as three ostrich eggs or 148 hen's eggs.

The remains of a deer have been found in Ireland measuring in height to the summit of the antlers, ten feet, with a spread of the antlers from tip to tip of eleven feet.

It has been possible at this time to give only the briefest mention of some of the strangest and most gigantic of the extinct monsters which once inhabited this earth. They are all recognized as absolutely authentic by scientists, testified by the incontrovertible proof of their remains, fossil or otherwise. In the era that preceded the birth of man, when animal life took these strange forms and vegetation was hardly less grotesque and gigantic in comparison with the world of to-day, is a field for study of unending interest and variety. What would we not give for actual landscape photographs of those wonderful scenes!



MAN AND NATURE BEFORE THE DELUGE

It is an accepted fact that the science of the earth and the wonders of nature have their culmination and terminus in man, the final link in the chain of life. A famous Canadian geologist, Sir J. W. Dawson, in one of his works makes an interesting study to answer the question, if possible, how and when this chief cornerstone was placed upon the edifice of nature. He puts this in the form of a narrative, based on geo-

logical facts only, and from his chapter on the subject of early man, the following paragraphs are condensed.

The glacial age had passed away. The lower land, in great part a bare expanse of mud, sand and gravel, had risen from the icy ocean in which it had been submerged, and most of the mountain tops had lost their covering of perpetual snow and ice. The climate was ameliorated and the sun

At this time, somewhere in the warm temperate zone, in an oasis or island of fertility, appeared a new thing on the earth.

A man and woman, walking erect in the forest glades, bathing in the waters, gathering and tasting every edible fruit, watching with curious and inquiring eyes the various animals around them, and giving them names which might eventually serve not merely to designate their kinds, but to



STELLER'S SEA COW. LENGTH, THIRTY-FIVE FEET.
Found alive by Steller at Behring's Island in 1741, but extinct since that time.

again shone warmly on the desolated earth. Gradually the new land became overspread with a rich vegetation, and was occupied by many large animals. There were species of elephant, rhinoceros, horse, bison, ox and deer, multiplying until the plains and river valleys were filled with their herds, in spite of the fact that they were followed by formidable carnivorous beasts, fitted to prey on them.

express actions and emotions as well.

How this event happened, science is still unable to answer, and though we may frame many hypotheses, they all remain destitute of certain proof in so far as natural science is concerned. We can here only fall back on the old traditional and historical monument of our race, and believe that man, the child of God and with God-like intellect, will and consciousness,

was placed by his maker in an Edenic region and commissioned to multiply and replenish the earth. The when and where of his introduction, and his early history, when introduced, are more open to scientific investigation.

That man was originally frugivorous, or fruit- and grain-eating, his whole structure testifies. That he originated in some favorable climate and fertile land is equally certain, and that his surroundings must have been of such a nature as to give him immunity from the attacks of formidable beasts of prey also goes without saying. These are all necessary conditions of the successful introduction of such a creature as man, and theories which suppose him to have originated in a cold climate, to struggle at once with the difficulties and dangers of such a position are, from the scientific point of view, incredible.

But man was introduced into the wide and varied world, more wide and varied than that possessed by his modern descendants. The earliest men that we certainly know inhabited our continents when, as we know, from ample geological evidence, the land of the northern hemisphere was much more extensive than at present, with a mild climate and a rich flora and fauna. If he was ambitious to leave the oasis of his region, the way was open to him, but at the expense of becoming a toiler, an inventor and a feeder on animal food, more especially when he should penetrate into the colder climates. The details of all this as they actually occurred are not within the range of scientific investigation, for these earlier men must have left few if any monuments, but we can imagine some of them.

Man's hands were capable of other uses than the mere gathering of food; his mind

was not an instinctive machine like that of the lower animals, but an imaginative and inventive intellect, capable of adapting objects to new uses, peculiar to himself. A fallen branch would enable him to obtain the fruits that hung higher than his hands could reach. A pebble would enable him to break a nut too hard for his teeth. He could easily weave a few twigs into a rough basket to carry the fruit he had gathered, to the cave or shelter or spreading tree or rough hut that served him for a home; and when he had found courage to snatch a branch from some tree ignited by lightning, and to kindle a fire for himself, he had fairly entered on that path of invention and discovery which has enabled him to achieve so many conquests over nature.

Our imagination may carry us yet a little farther with reference to his fortunes. If he needed any weapon to repel aggressive enemies, a stick or club would serve his purpose, or, perhaps, a stone thrown from his hands. Soon, however, he might learn from the pain caused by the sharp flints that lay in his path the cutting power of an edge, and armed with a flint chip held in the hand or fitted into a piece of wood he would become an artificer of many things, useful and pleasing. As he wandered into more severe climates where vegetable foods could not be obtained throughout the year, as he observed the habits of beasts and birds of prey, he would learn to be a hunter and a fisherman and to cook animal food, and with this would come new habits, wants and materials as well as a more active and energetic mode of life.

He would also have to make new weapons and implements, axes, darts, harpoons, scrapers for skins, and bodkins or needles to make skin garments. He would use

chipped flint where this could be procured, and, failing this, splintered and rubbed slate, and for some uses bone and antler. Much ingenuity would be used in shaping these materials, and in the working of bone, antler and wood, ornaments would begin to be studied. In the meantime, the hunter, though his weapons improved, would become a ruder and more migratory man, and in anger or in desire to gain some coveted object, might begin to use his weapons against his brother man. In some more favored locations, however, he might attain to a more settled life, and he, or more likely the woman, his helpmate, might contrive to tame some species of animals and to begin some culture of the soil.

It was probably at this early time that metals first attracted the attention of man. The ages of stone, bronze and iron believed in by some archæologists are more or less mythical to the geologist, who knows that these things depend more on locality and on natural products than on stages of culture.

Probably all these ends had been to some extent and in some localities attained in the earliest human period, when man was contemporary with many large animals now extinct. But a serious change was to occur in human prospects. Hilltops, long denuded of the snow and ice of the glacial period, were again covered, and cold winter sealed up the lakes and rivers and covered the ground with wintry snows of long continuance. With this came a change in animal life and in human habits. Now began a fierce struggle for existence in the more northern districts inhabited by man, a struggle in which only the hardier and ruder races could survive, except, perhaps, in some of the more genial portions of the

warm temperate zone. Men had become almost wholly carnivorous, and had to contend with powerful and fierce animals. Tribe contended with tribe for the possession of the most productive and sheltered habitats. Thus the struggle with nature became aggravated by that between man and man. Violence disturbed the progress of civilization, and favored the increase of power of the rudest tribes, while the more delicately organized and finer types of humanity, if they continued to exist in some favored spots, were in constant danger of being exterminated by their fiercer and stronger contemporaries.

In mercy to humanity this state of things was terminated by a great physical revolution, the last great subsidence of the continents, that post-glacial flood which must have swept away the greater part of men and many species of great beasts, and left only a few survivors to repopulate the world, just as the mammoth and other gigantic animals had to give place to smaller and feebler creatures. In these vicissitudes it seemed determined, with reference to man, that the more gigantic and formidable races should perish, and that one of the finer types should survive to repopulate the world.

Thus we have followed, as closely as science can interpret the chronicles, the progress of mankind from the creation to the deluge, and his development of the natural conditions in which he found himself. It is a fascinating study and an inexhaustible one. As the poet has aptly said, "The proper study of mankind is man," and these pioneers of our race are entitled to full attention in connection with the other wonders of the natural world, which we have inherited from them.



FLAGS OF ALL NATIONS.



FLAGS OF ALL NATIONS.

BOOK V

THINGS WE ALL SHOULD KNOW

CIVIL SERVICE AND ITS LAWS

Properly speaking, civil service means the service of all persons in the employ of government, national, state or municipal, except those in the army and navy. Civil service, therefore, existed from the time of the foundation of the government. But civil service reform, growing out of the abuses that were saddled upon public office, is of comparatively recent growth in this country. The general practice in the national government was that with every change of presidents from one party to another, there should be a clean sweep of all employes under the government, irrespective of merit, age or period of service, with the broad rule applied, "to the victors belong the spoils."

Finally it began to be recognized that there should be no "spoils," that "public office is a public trust," that faithful and competent service should assure permanence, and that the whole system in effect was unnatural and unwise, as well as highly improper. Earnest men, true patriots, began to plan for improvement, and now the country sees less and less of the unseemly scrambles for official place and plunder that used to be the chief evil of changing administrations.

The act of January 16, 1883, popularly known as the civil service act, is entitled

"An act to regulate and improve the civil service of the United States." Its purpose, as its title indicates, was to correct certain conspicuous abuses which were then prevalent in connection with the appointment and promotion of civilian employees in the executive branch of the government, and at the same time to improve that part of the public service by increasing the efficiency of the employes, and thus securing a more satisfactory and economical administration of public affairs. In the departments at Washington the classification embraced all persons receiving salaries of not less than \$900 nor more than \$1,800 a year—altogether 5,652—of whom 135 were excepted from examination. The classification of the Customs Service embraced places having an annual compensation of \$900 or over, at ports where 50 or more persons were employed, excluding only those whose nominations had to be confirmed by the Senate. The number of places thus classified, including eleven ports, was 2,573. The number of postoffices classified—being those at which there were 50 or more employes—was 23, and the classified service at these offices included all persons above the grade of workman or laborer except the postmasters, or 5,699 in all. In the three branches of the classified service, therefore, the total

number of places made subject to the provisions of the civil-service rules was 13,924. By March 3, 1885, President Arthur, under whom this act became a law, had extended its operations to include 15,573 places. By March 3, 1889, President Cleveland caused it to include 27,330 classified places. By March 3, 1893, President Harrison had extended it to 42,928 places. At this time Secretary Tracy, with the approval of the President, put the Navy Yard Service under the merit system, thus classifying about 5,000 employes. By March 3, 1897, President Cleveland caused the act to cover 81,889 classified places. By June 30, 1901, President McKinley had added 2,233 places to the civil-service list, and under his administration, under various rulings, there were 19,423 places dropped from the merit system and restored to the list of purely appointive offices.

President Roosevelt caused nearly all of the more important places to be restored, and extended as rapidly as possible the merit system over the newly acquired dependencies and colonies.

EXTENT OF THE SERVICE.

It is estimated that the number of positions in the Executive Civil Service is now about 210,000, of which approximately 90,000 are classified competitive positions, 100,000 unclassified, and somewhat less than 20,000 are classified but not subject to competitive examination. Less than 20,000 of the official force are employed in Washington, D. C. Most of the unclassified positions are held by fourth-class postmasters, of whom there are more than 72,000.

Under the act of April 12, 1900, the United States Civil Service supplanted the

military service in Porto Rico. Inasmuch as the executive officers and employes under this act become a part of the Executive Civil Service of the United States, they are properly subject to the provisions of the Civil Service acts and rules. On July 5, 1900, the Secretary of the Treasury, with the President's approval, issued an order classifying and including within the provisions of the Civil Service law and rules the officers and employes in and under the Treasury Department of Porto Rico, excepting persons appointed with the advice and consent of the Senate and persons employed as mere laborers or workmen. On August 29, 1900, the Postmaster-General informed the Commission that the United States Postoffice Department, on May 1, 1900, assumed control of the free-delivery service at Mayaguez and San Juan, Porto Rico. The Commission approved the lists of carriers transmitted therewith and authorized the treatment of the offices as free-delivery offices.

On July 5, 1900, the Secretary of the Treasury issued an order classifying the employes of the Treasury Department in Hawaii. The order is similar in scope and language to that of the same date relating to Porto Rico.

On September 19, 1900, the United States Philippine Commission passed an act entitled "An act for the establishment and maintenance of an efficient and honest civil service in the Philippine Islands." In introducing the measure President Taft said:

"The purpose of the United States Government and the people of the United States in these islands is to secure for the Filipino people as honest and as efficient a government as may be possible. It is

deemed by the Commission and by the Government which the Commission represents to have every feature of this bill consistent with the Government. The danger in any government, whether it be republican or monarchical, is that public office be used for private purposes. All countries have suffered from this evil, and those countries in which a thorough system of civil service is selected are the first to minimize that danger."

HOW TO ENTER THE CIVIL SERVICE.

Persons seeking to be examined must file an application blank. The blank for the Departmental Service at Washington, Railway Mail Service, the Indian School Service, and the Government Printing Service should be requested directly of the Civil Service Commission at Washington. The blank for the Customs, Postal, or Internal Revenue Service must be requested in writing of the Civil Service Board of Examiners at the office where service is sought. These papers should be returned to the officers from whom they emanated.

Applicants for examination must be citizens of the United States, and of the proper age. No person using intoxicating liquors to excess may be appointed.

A set of specimen examination questions covering all the departments has been prepared by the Commission, with full information as to examinations. This is published in a pamphlet under the title, "Manual of Examinations," and may be obtained free of charge by writing to the United States Civil Service Commission, Washington, D. C. It can also be obtained from any postoffice where there is a civil service department.

The age limitations for entrance to posi-

tions in the different branches of the service are as follows:

	Mini- mum.	Maxi- mum.
Departmental service:		
Page, messenger boy, apprentice, (other than apprentice in mints and assay offices) or student.....	14	20
Apprentice in mints and assay offices..	18	24
Printer's assistant and messenger.....	18	No limit.
Positions in the Railway-Mail Service.	18	35
Internes and hospital stewards in the Marine Hospital Service and acting second assistant engineer in the Revenue-Cutter Service	21	30
Keeper, assistant keeper and officers of light-house tenders and light vessels in the Light-House Service.....	18	50
Cadet in the Revenue-Cutter Service and aid in the Coast and Geodetic Survey	18	25
Surfman in the Life-Saving Service....	18	45
Superintendent, physician, supervisor, day-school inspector, disciplinarian, matron, and assistant matron in the Indian Service; inspector and assistant inspector of hulls and inspector and assistant inspector of boilers in the Steamboat-Inspection Service.....	25	55
Observer in the Weather Bureau Service	18	30
All other positions.....	20	No limit.
(The age limitation shall not apply in the case of the wife of the superintendent of an Indian school who applies for examination for the position of teacher or matron.)		
Custom-House Service: All positions....	20	No limit.
Post-Office Service:		
Rural letter carrier.....	17	55
All other positions.....	18	45
(The age limitations shall not apply in the case of an honorably discharged United States soldier or sailor of the civil war or of the Spanish-American war who applies for the position of rural letter carrier.)		
Government Printing Service:		
All positions (male).....	21	No limit.
All positions (female).....	18	No limit.
Internal-Revenue Service: All positions.	21	No limit.

The inestimable value of the merit system to good government is now so universally admitted, and so unassailable from both moral and economic standpoints, that it is being extended throughout the entire field of public service.

Civil Service on the merit system in the cities is making notable progress, as in Chicago, New York and Boston, while in other cities it is still struggling against the spoils system of the professional politicians.

The merit system of the Civil Service is likewise making notable progress among the States, as in New York and Massachusetts, where a practical economic system is now in effective operation.

Likewise many counties of the various

States have adopted civil service rules in which there shall be "no dismissal except for cause, no promotion except for merit." In this way the office spoilsmen among professional politicians can not cause the dismissal even of a janitor without due trial and conviction of a misdemeanor.



COMPULSORY EDUCATION

Most of the States of the Union, and the District of Columbia, have compulsory education laws under various conditions, many of them made partly ineffective by exceptions.

In Ohio the law is inoperative where the seating accommodations of the school houses are insufficient.

In Massachusetts, the four Cape Cod counties and the mountain counties of the west are exempt.

In the various States, required attendance varies as to age from 7 years to 16 years. The prevailing limits are 8 to 14 years, and as to time, from eight weeks in Kentucky to the entire term taught in Massachusetts and Connecticut.

Where the penalty is on the parent, it varies in fines from \$1 in New Mexico to \$200 for repeated neglect in Nevada.

The penalty is in numerous places on the child. In Maine if the child is between 10 and 15 years of age and guilty of repeated truancy, it is sent to the reform school; in New Hampshire to industrial school; in Massachusetts, between 7 and 16, to truant school; in Rhode Island to any designated institution; in New York to truant school; in New Jersey to juvenile reformatory, if over 9 years of age; in Pennsylvania to local truant school; in

Ohio to a reformatory; in Indiana to a parental home provided by the school board; in Michigan to an ungraded school provided by the board.

Penalties varying from \$10 to \$100 for non-enforcement of the law are set upon officers in the states of Maine, Vermont, Pennsylvania, West Virginia, Kentucky, Ohio, Wisconsin, Minnesota, North Dakota, South Dakota, Kansas, Montana and California.

In most of the states where there are state institutions for the deaf, dumb and blind, there is compulsory attendance at the parents' expense if they are able.

Exemptions from compulsory attendance are granted for distance from nearest school as follows: California, one mile; Pennsylvania, Kentucky, West Virginia, Indiana, Michigan, Wisconsin, Minnesota, Kansas, Colorado, Nevada and Oregon, two miles; North Dakota, Montana, Utah, two and one-half miles; Idaho, three miles.

A physician's certificate for bodily or mental ailments will exempt children in Indiana, North Dakota, Montana, Wyoming, New Mexico and Utah. In Washington defective children must be sent to state institutions. Poverty is an exemption in the District of Columbia, Nebraska, Rhode Island, Kentucky, Minnesota, Kansas, Montana and California.

The need of the child's service for support of parents exempts it from attendance in Utah, and, for any relative, in Illinois.

Any urgent reason exempts from the law in Pennsylvania and Wyoming.

In Wisconsin and Illinois it is necessary to obtain a decision from a court of record.

In Ohio, the decision of a probate judge on appeal will exempt.

By enactment of the legislatures, in case of poverty, clothing and books are furnished free in Vermont, by the town; in Indiana by the county; and in Colorado by the district. Elsewhere certain local provisions are made for the same purpose.

The following states have made legal provisions for transporting children to school at public expense: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Iowa, North Dakota and Nebraska, while partial provisions are made in Rhode Island, Wisconsin, Ohio, Pennsylvania and South Dakota.

CHILD-LABOR LAWS.

In New Hampshire, no child under 10 years of age may be employed in a manufacturing establishment, nor one under 16, who cannot read and write, during time schools are in session, under a penalty on the employer not to exceed \$30.

In Vermont no child under 14 years is to be employed in any mill or factory unless he has a certificate of school attendance of 14 weeks in the year.

In Massachusetts no child under 14 years of age can be employed during the school term, nor for any work earlier than 6 A. M. or later than 7 P. M. No one under 16 can be employed during school term without a certificate of attendance for the required time, nor any minor over 14 who cannot read and write, during the time when there is a local evening school, unless he shall be attending the same. The penalties on employers are from \$5 to \$50.

In Rhode Island no child under 12 years can be employed during the school year without a certificate of having attended school eighty days. Fines not to exceed \$20.

In Connecticut no child under 14 can be employed who has not a certificate of sixty days' attendance at school. Penalty not to exceed \$60.

In New York no child under 12 can be employed during school term, nor for the next two years without a certificate of eighty days' attendance. Penalty \$50.

In New Jersey no child under 15 years can be employed without a school certificate for twelve weeks of consecutive attendance. Penalty \$10 to \$25 or imprisonment one to three months.

In Ohio no child under 14 years can be employed without a certificate of sixteen weeks' attendance. Penalty \$25 to \$50.

In Illinois no child shall be employed which is under 13 years, for any period of time greater than one day, without a certificate from the school board that the child's service is necessary to support an infirm relative. Penalty, every day being an offense, \$10 to \$50.

In Michigan every child under 14 years must have attended school four months immediately previous to employment. Penalty \$5 to \$10 for first offense and not less than \$10 for each subsequent offense.

In North Dakota and South Dakota no child under 14 can be employed, except by parents or guardians, while the local public schools are in session, without certificate of twelve weeks' attendance. Penalty \$20 to \$50 and costs in North Dakota, and \$10 to \$20 in South Dakota.



STANDARD TIME OVER THE WORLD

When transportation was slow and of small amount, the question of differences in time was of small account, but with the

advent of swift movements along parallels of latitude, in the vast volume of traffic of recent years, the problem became one of intolerable perplexity and danger.

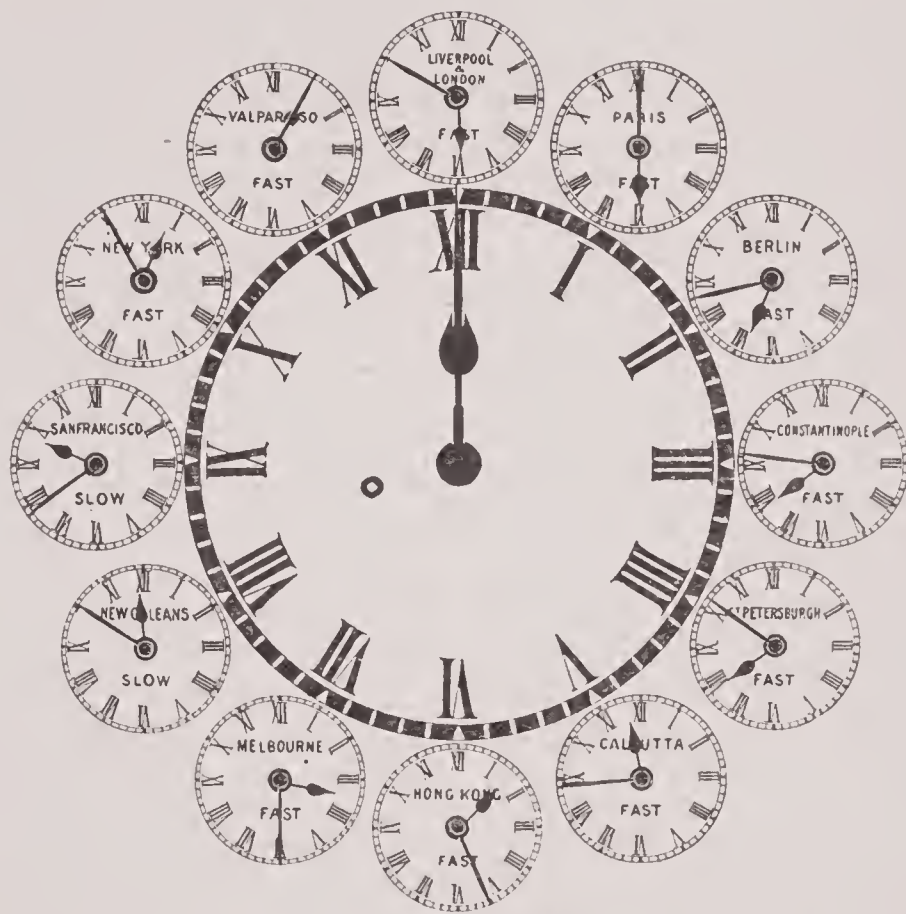
Scientific discussion had been going on for years with many suggestions and plans for relief, when in 1884, a conference was held in Washington which divided the world into zones or time belts with the meridian of Greenwich, five miles south-east of London, as a basis. The observatory at Greenwich, which is almost universally the calculating point for the geographical measurements of longitude, was erected by Charles II. for the advancement of navigation and nautical astronomy. It now transmits the time by magnetic

currents to all England and is the chief nautical reckoning point for the rest of the world.

Before the general establishment of what is known as standard time, each town on a given parallel had a different time from that of its neighbor, in accordance with the movement of the sun, but to the confusion of all railroad time. For the public con-

venience, the United States was divided into four sections or belts of 15 degrees, or one hour each, to be known as Eastern, Central, Mountain and Pacific time. To accommodate the general divisions of the railroads, the dividing lines are drawn irregularly from north to south through railroad terminals or principal towns. On that account, Eastern time includes all the territory between the Atlantic coast and a

line drawn from Detroit to Charleston, South Carolina. Central time includes all west to the irregular line drawn from Bismarck, North Dakota, to the mouth of the Rio Grande. Mountain time extends to the western borders of Idaho, Utah and Arizona, while the remainder west is Pacific



CLOCK INDICATING SIMULTANEOUS TIME AROUND THE WORLD.
The center dial represents noon at Chicago and a corresponding variation may be calculated for any hour in the day.

time. Thus twelve noon in Eastern time is eleven a. m. in Central, ten a. m. in Mountain and nine a. m. in Pacific time. This is easily understood from the fact that it requires an hour for the sun to pass over a little more than a thousand miles, therefore the sun rises upon or is perpendicular over the eastern end of a thousand miles one hour before it is in the same position at

the western end. Standard time for the United States is supplied by the Naval Observatory at Washington. The exact hour of twelve o'clock noon is determined every day by astronomical observation, and the precise time is transmitted to the clocks of the government departments by electricity. The telegraph companies are permitted to telegraph the time thus taken by automatic instruments to all parts of the United States. The instrument at San Francisco registers the time within a fifth of a second after it is taken at Washington, D. C. To do this the telegraph company clears all its wires throughout the United States of all business, three minutes before noon each day, and thus unbroken connection is established over the entire telegraph system of the country.

Not alone is the exact time sent instantly to all parts of the Union, but the extensive system of private and business clocks connected with the telegraph lines are, by an electrical device, regulated together. This is done in each clock by means of an electro-magnet operating a clamp. The magnet is filled with electric force when the circuit is closed to give the noon signal, and the hands of the clock are forced to the exact point of twelve. The telegraph company charges \$15 a year for each clock and fully \$1,500,000 a year is earned by this service. More than ten thousand clocks are thus regulated in New York City alone.

From the staff of the Naval Observatory at Washington a great red ball drops exactly at noon every day, and those seeing it can regulate their watches and clocks accordingly. In seaport towns balls are dropped in the same manner and the seamen can thereby regulate their watches.

PUBLIC LIBRARIES, THEIR GROWTH AND ADMIN- ISTRATION

The administration of a great library, in order to make it most serviceable to those who patronize it, has become one of the learned professions of late years, so rapid has been the growth of the institutions and the uses to which they are put. Architects make special preparation to qualify themselves for the building of libraries. Colleges and universities give special courses for the instruction of librarians in the various departments of their work. Philanthropists have learned that there is no use to which they may put their benefactions for the public good surpassing the gift of funds for the establishment or the extension of libraries, and the reading public, realizing the remarkable advantages to which it has access since libraries so multiplied, gives closer attention to literature and keeps the attendants busy serving the wants of those who love books.

In 1900 there were in the United States 5,383 public, society and school libraries containing 1,000 or more volumes each. The total number in these collections was 44,591,851, or 35 per cent more than in 1896, when the number was 33,051,872. There is one library of more than 1,000 volumes for every 14,118 persons, and there are fifty-nine books for every one hundred of the population. All of these figures entirely exclude all private and small collections, which would increase the total enormously, for there are multitudes of private libraries exceeding 1,000 volumes.

There are fifty-three national and state libraries, of which the Library of Congress, at Washington, is the largest, with more

than 1,000,000 volumes. In addition to this library the House of Representatives, the Senate and the various departments of the government have their



LIBRARY BOOK STACK ROOM.

special collections of books for immediate use, so that the total number of volumes belonging to the government in Washington exceeds 2,000,000. The largest of the state libraries is that of New York, at Albany, with 423,290 volumes.

Of the thirty-six free public libraries of 50,000 or more volumes, that of Boston is the largest, with 772,432 books on its shelves. Thirty-two universities and colleges have libraries of more than 50,000 volumes, and of these Harvard University

stands at the head with 560,000 books. There are thirty-seven other libraries in the United States exceeding 50,000 volumes each, belonging to various societies and special collections and extending in several instances to more than 200,000 books.

It is edifying to notice a single city as an example of the wealth of library material in the United States. In Chicago the free public library has a total of 272,276 volumes and 49,805 unbound pamphlets. The aggregate circulation for a single year approaches 2,500,000 volumes, which does not include the use of books kept on open shelves, nor the periodicals and newspapers used in the reading rooms. The splendid public library building which shelters this collection was erected at a cost of several hundred thousand dollars, and is equipped with every modern appliance known to library experts. Of course, it is fireproof throughout, being built entirely of steel.



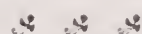
DYNAMOS AND VENTILATING PIPES, CHICAGO PUBLIC LIBRARY.

cement, glass and tiles. The book stacks or shelves are made of steel. The ventilation of the library is arranged according to a system which makes it unnecessary to open the windows and admit the dust and soot, which are so disastrous to books. All air for ventilation is admitted through the basement, where it is filtered and cleaned before being distributed throughout the building by an intricate system of large pipes and fans.

In addition to this library, in Chicago there is the John Crerar library, with more than 75,000 volumes, the Newberry free library with 250,000 volumes, the Chicago Historical Society library with 27,000 volumes and 60,000 pamphlets, the Chicago Law Institute library with 40,000 volumes, the University of Chicago library with 335,000 volumes and 165,000 pamphlets, the Field Columbian Museum library and the library of the Armour Institute, each containing some 15,000 volumes. It is evident that no one need be denied reading matter in such a city for want of opportunity, and the other great cities of the United States make a showing equally creditable.

Andrew Carnegie, the great iron master, has paid special attention to public libraries in his immense contributions to charitable and educational purposes. It is calculated that he has given nearly \$15,000,000 for libraries in the United States and Scotland within the last two or three years. To New York city alone he gave \$5,200,000 to establish branch libraries. To St. Louis he gave \$1,000,000 for a public library, and to a total of nearly two hundred cities he has given public libraries ranging in cost from \$15,000 to \$750,000. In nearly every instance his gifts have been

coupled with the condition that a building site should be provided free of cost, and an appropriation for the annual maintenance of the library be made from public funds. By this means he has stimulated the gift and the expenditure of large sums of money in addition to those which he gave himself, and consequently the totals of his own contributions do not by any means measure the full amount given for such purposes in this country. Indeed, there have been several other gifts of public libraries, ranging in value from \$25,000 to \$150,000, by men who avowed themselves to be moved by Mr. Carnegie's generosity elsewhere, so that to him must be given a large share in the credit for the remarkable stimulus that has been given to library building within recent years.



AMERICAN COLLEGES AND THEIR GROWTH

It is a characteristic of this age of progress that attention is being paid to the intellectual side of life just as energetically as to industrial and commercial undertakings. Indeed, in many communities the development of the refinements of life is advancing with even greater rapidity. In the comparatively new cities of the Mississippi Valley and the Far West the men of energy and ability, until recently, have been forced to devote all their time and attention to the upbuilding of their own prosperity and that of the communities in which they live. They have had little leisure to think of anything except business. Of late years, however, with their fortunes established and business conditions fixed in more regular channels, they have had more lib-

erty of action for intellectual pursuits and recreation. The result is that our great merchants, miners, railway men, manufacturers and other captains of industry have turned into these finer pursuits the same energy and executive ability that have built great cities in a generation. The libraries, universities, museums, art galleries and other kindred institutions have grown like magic, with enormous rapidity, as a result of the immense gifts made for such purposes. While it is true that money cannot provide the venerable history and the schol-

record of 100 years behind them, and it is not strange that with such conditions they likewise excel in the number of students attracted to them. With unlimited money at their command they are able to employ faculties of the most distinguished scholarship. They offer likewise college libraries, gymnasiums, museums, laboratories and buildings themselves of the greatest, and many a young man passes by the school with the traditions in order to patronize one which has the newest dormitories.

The statistics of American colleges are



BUILDINGS OF COLUMBIA UNIVERSITY, NEW YORK CITY.

astic atmosphere that belong to the older institutions as qualities that come only with age, or the traditions that stimulate those who inherit the halls from which a century of distinguished men have issued, yet material equipment goes far to assist scholarship, and age will be provided by the passing years.

Some of the younger colleges, for instance, with a history dating back hardly ten years, already excel in their endowments and the facilities they offer to students, those institutions with an honorable

impressive as indicating the attention that young men and young women are giving to higher learning, and the assistance granted to such institutions either by the public in the state universities or by men of large wealth out of their private fortunes. In the United States there are enumerated 621 colleges, universities and seminaries for higher education which are authorized to grant degrees. In these 12,557 professors and instructors are employed in teaching 153,287 scholars. The income of these institutions annually reaches the immense

total of \$24,185,367. At least eight of these institutions have more than 3,000 students attending. Harvard University stands at the head of the list, with 5,150 students; Columbia University second, with 4,036, and the University of Michigan at Ann Arbor third, with 3,800, the latter being the largest of all the state universities supported by public funds. The University of Chicago, which, under its present organiza-

activity in the affairs of every-day life. With the great increase in their financial resources they have entered the field of scientific exploration all over the world, as well as the field of publication with the literary results of their explorations and discoveries. College sports have become of interest, not alone to the young men who share in them, and to their institutions, but to the public at large, so that their foot-



BUILDINGS OF THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

tion, is hardly ten years old, has more than 3,500 students.

Colleges and universities, generally speaking, have been broadening their work and their policies of late years, confining themselves less to instruction in the classics and mathematics and giving more attention to modern languages, literature and the sciences. They have come closer to the life of the people, and have taken a larger

ball, baseball and boat races are considered among the most important sporting events every season. Even the most conservative and scholastic of the universities and colleges yield to these changing conditions, and even though they may sometimes consider that these sports hold too prominent a place in the life of an educational institution they realize the advertising value of publicity, and that their new classes each

year are in large degree attracted by the athletic successes of the respective institutions.

It is impressive to note the immense gifts that have been made within the last few years to certain colleges and universities by some of our wealthy Americans. Andrew Carnegie has given \$10,000,000 to establish the University of the United States at Washington, and \$10,000,000 to the Scotch universities, all within a single year. John D. Rockefeller, in the same year, 1901, gave \$2,000,000 to American colleges, and within ten years has given to the University of Chicago approximately \$8,000,000. Mrs. Stanford, in 1901, gave to Leland Stanford Junior University in California, property valued at \$30,000,000, and the bequests of her husband and her own gifts prior to that time had already amounted to many millions. Mrs. Hearst gave to the University of California property amounting to more than \$10,000,000. Cecil Rhodes in his will left sums amounting to \$20,000,000 to assist the cause of education in the English universities, this amount to be available as scholarship funds for students from England, the British colonies and the United States. D. K. Pearsons of Chicago has given more than \$3,000,000 to colleges throughout the United States within the last few years. Mrs. Joseph L. Newcombe in 1901 gave \$3,000,000 to Tulane University at New Orleans.

The foregoing are but the greatest gifts out of a long list. Several others could be named, amounting to \$1,000,000 each, and scores of sums from \$10,000 upward. In most cases the amounts were given on condition that the institutions to which the money was granted would raise similar sums through subscriptions from alumni

and other friends, so that the amounts given in large sums have been virtually doubled by the raising of smaller amounts.

No one can fail to appreciate the great significance of such an educational movement. It is a recognized fact that education does more to advance the true welfare of a nation than any other influence that can be enlisted, and American colleges and universities have always been a factor of great importance in influencing the national life and policies on important questions at issue. With education multiplying as it is sure to do rapidly under the impetus given it during the closing years of the last century, we may expect to see even greater results in the future than there have been in the past.



AMERICAN COLLEGE SPORTS

Probably no other influence has been as effective in making athletic sports generally popular as has been the great interest taken in them by the young men of American colleges. Leading a studious life through a large part of their time as they do, it is necessary for them to take every opportunity for outdoor exercise, for the sake of their health and the quality of their work. Stimulated to rivalry, first among themselves in their own colleges as they are, and then by loyalty to their institutions to rivalry with other neighboring schools, the spirit of emulation has grown, until now the annual competitions and events in athletic sports have become almost a supreme factor in the college year to hosts of young men.

In the fall, each year, football holds the place of highest importance, and in the spring baseball takes a corresponding rank.

As incidental factors throughout the year come contests in tennis, track athletics, gymnasium athletics, rowing, and other sports.



BRINGING OUT THE SHELL.

There are many colleges which do not have access to water, and consequently cannot enter the rowing competition. Those which are located more favorably, however, either at the seashore or beside some lake or river, find in these contests one of the most important events of the year and one which attracts to it thousands of visitors from far away. The "big race" every year, as it is considered in the college world, is that of the eight-oar crews of Yale and Harvard Universities, usually rowed at New London, Connecticut, on the Thames river. On the same day there is also a race between four-oar crews and freshmen crews from the same universities, and the three events serve to make the day

an important one in college athletics. These, however, are not the only college crews that race every year, with great importance placed upon the victories. In this country Princeton, Columbia, Cornell, Pennsylvania and other eastern universities, and several of the large western colleges and universities arrange similar events, while in England the annual race between Oxford and Cambridge attracts world-wide interest.

The apparently frail craft in which these races are rowed cut through the water at an astonishing speed, the rowing records



THE POLE VAULT.

for college teams being as low as four miles in a few seconds more than twenty minutes.

Almost every American college and school, from Harvard and Yale down to

the smallest village grammar school, has its series of games for the football championship every fall. When Harvard and Yale, Princeton and Columbia, or Pennsylvania and Cornell play their annual game, whether it be in New York, Boston or elsewhere, on Thanksgiving day, thousands of enthusiasts make riotous applause for the victors on whose strength and agility so much depends. In New York, for instance, 60,000 people have been known to be present at such a game. Thanksgiving day, indeed, has become known as the great day for football events the country over. This is one game into which professionalism has entered hardly at all, fortunately for athletic sports.

Another noteworthy game of football is that played between the cadet teams of West Point and Annapolis. It is the army against the navy in this instance, and the young cadets from the two national schools of warfare fight bravely to win the honor for their respective arms of the service. The same energy that they display at this time in a manly spirit of athletic rivalry is the quality which serves them well in later years when they enter more important undertakings in the service of their country. An accompanying illustration represents one of these games, played at Philadelphia on the field of the University of Pennsylvania. More than 30,000 spectators witnessed the spirited contest. Among them were President Roosevelt and the members of his cabinet, the members of the Senate and the House of Representatives, and a number of distinguished officers of the army and the navy. Many special trains ran from Washington, New York and the other neighboring cities to accommodate the immense crowds that desired to view the contest between the young men who are to be our future generals and admirals.



COLLEGE CREW IN AN EIGHT-OARED RACING SHELL.

OCEAN, LAKE AND MOUNTAIN RESORTS

In spite of the energy and fidelity with which Americans stick to their business at all hazards, there are few countries where great summer and winter resorts are more highly developed than they are in the United States. On the Atlantic coast, from Maine to New Jersey, a succession of beautiful summer resorts have grown up, where splendid hotels, attractive bathing beaches and the other conditions which make such places pleasurable, attract hundreds of thousands of visitors every year. At Atlantic City, New Jersey, is the dividing line between the winter and summer coast resorts, for here in both seasons visitors crowd the hotels. Further south it is chiefly winter travelers who patronize the seaside, all the way down to the tip of the Florida peninsula and thence around the coast of the Gulf of Mexico to the Texas cities themselves.

The coasts of the New England states, and Long Island, Delaware and New Jersey, are marked with charming resorts every few miles. Florida, with its splendid hotels facing the gulf, forms a distinct resort region of its own for the winter. From Mobile, Alabama, to New Orleans, facing the Gulf of Mexico, is a shore which the southerners term the American Riviera. On the Pacific another distinct group of resorts has developed, from San Diego in the south to Alaska in the north. San Francisco becomes the dividing line between the summer and winter resorts on this coast. Southward from the metropolis of California are such beautiful winter resorts as Monterey, Santa Barbara, Santa Catalina, Los Angeles and San Diego, while northward in the summer multitudes of tourists



FOOTBALL GAME BETWEEN ANNAPOLIS AND WEST POINT CADETS AT UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

President Roosevelt, his cabinet, both houses of Congress and hosts of distinguished citizens were among the 50,000 spectators present. Special trains from New York, Washington and elsewhere helped to swell the crowd.

take advantage of the mountain and coast beauties of Puget Sound, British Columbia, and the Alaskan shores even further north. Monterey and Santa Catalina, likewise, are almost as popular in the summer as in the winter.

Between these two oceans a limitless variety of pleasure grounds await the vacation wanderer at any season. The mountains of New England, the Adirondacks, the Georgia pines, the lakes of Michigan, Wisconsin and Minnesota, the mountains of California and the far west offer choice inexhaustible. Nature has given to this country as lavishly of opportunities for pleasure in wholesome climates and among beautiful surroundings as it has given of the wealth of the forests, the mines and the farm. He would be exacting indeed who should fail to be satisfied in whatever direction he desired to use his activities of mind and body.



WINTER SPORTS IN NORTHERN CITIES.

Every country has sports peculiarly its own in the beginning, and those that are best for general use are invariably passed over the boundaries into neighboring countries for appreciative adoption there. It is to Canada, thanks to its cold but favorable winters, that the world owes the development of some of the most wholesome, enjoyable and picturesque of athletic sports. In Quebec, Montreal, Ottawa, Toronto, Winnipeg and a host of smaller cities of the Dominion of Canada, the winter is the season of greatest merriment, the time of most active outdoor life. The low temperature and the deep snow are themselves the factors of which the people take advantage to have their jolliest times.



BATHING BEACH, PIER, PAVILION AND THE FAMOUS BOARDWALK, ATLANTIC CITY, N. J.

Sleigh riding and coasting, which in the cities a little farther south are uncertain treats, here become the standard form of amusements through the long winters. The Canadian hills are gay with the bright costumes of multitudes of merry coasting parties. It is here that that most picturesque of snow craft, the toboggan, has been developed to the fleet vehicle used so generally, as a substitute for the ordinary sled with runners, on Canadian hills. The toboggan, indeed, of late years, has been introduced to a considerable extent into the United States, where it has gained much popularity. Instead of runners it has a smooth, polished surface for its whole width, and in an icy trough worn upon the steep hillside the coasters attain a breathless speed before they reach the bottom of the decline. Here, too, in all their picturesque beauty, are seen the gay costumes of many-colored blanket cloth worn as suits and dresses by the young men and women.

The snowshoe is another Canadian improvement of a primitive Indian invention. Over the deep snows which gather in the northern winters the snowshoes bear the sportsman without trouble, so that he may race or hunt at will, uninterrupted by the drifts.

Of course skating is as popular during the Canadian winter as it is in other countries where cold weather comes in earnest. The rivers and lakes, however, are usually covered with snow to such an extent that skating is virtually confined to large rinks which exist in every city, where brilliant illumination helps to make the scene within more gay than it might otherwise be.

Ice-boating, too, has its devotees in Canada. This inspiring sport, however, has its chief favor on the Hudson river and on some lakes of New York and Wisconsin.



CROWD ON THE FAMOUS BOARDWALK WATCHING BATHERS ON THE BEACH AT ATLANTIC CITY, N. J.



ON THE TOBOGGAN SLIDE—CANADA'S FAVORITE WINTER SPORT.



"THE BOUNCE."

Ice-boats are built in triangular form, resting on three skates, the one in the rear serving as a rudder. They have no cabins, and are but skeleton craft, sliding over the ice at railroad speed and carrying a spread of canvas like that of a small yacht. Experts in handling ice-boats are able to maneuver them in any direction as readily as their cousins at sea are handled, and there is no more beautiful sight than a race between a fleet of these picturesque craft.

As a center of winter sport, and an attraction for multitudes of visitors, Quebec, Montreal, Winnipeg, St. Paul and one or two other cities at various times have built great palaces and castles of ice. Some of these have been noteworthy for their architectural beauty and grace no less than for their novelty. Balls and festivals, illuminations, fireworks, sham battles, and other

sports more truly a part of winter festivities, have centered around them to make carnivals of winter which have attracted thousands of travelers from long distances to witness the novel and beautiful scenes.

If one has the instinct for outdoor pleasure, and is resourceful, he will discover that there is no season when nature does not offer some means of sport, both whole-



OVER THE HURDLE IN A SNOWSHOE RACE.

some and entertaining, and winter nowadays does not stand at the bottom of the list.



HORSE RACING THE WORLD OVER

Horse racing for many generations has been called the "sport of kings," and never has there been a time when the sport was more popular or more widely enjoyed than it is today. "It is differences of opinion that make horse races," said a clever writer, and there are few countries where the people do not differ as to the merits of their

respective steeds, and back their judgment for a race to test the facts. It is hard to travel to a land so remote that horse races are not popular events in the year's sporting annals. In Melbourne, the temporary capital of Australia and the metropolis of that island continent, is a race course in

States as well. In this city of less than 500,000 inhabitants, 100,000 persons will gather at Flemington race course on the day of the Melbourne Cup race, and the prize to the winner of the race sometimes amounts to as much as \$75,000.

Far on the other side of the world from



"DERBY DAY" AT WASHINGTON PARK RACE COURSE, CHICAGO.

which the people take pride, claiming it to be the finest in the world. And there at Flemington, once a year, is run a race for a prize known as the Melbourne Cup, which attracts visitors not merely from all the neighboring colonies of Australia but actually from England and the United

Melbourne, in May every year, the people of London, and, indeed, strangers from all the world, gather at Epsom Downs to see the Derby. Unlike most race courses there is no charge made for entering the course at Epsom Downs and viewing the race, and thus, with free admission as a temptation,

literally thousands of people spend the night before the race walking the twenty miles from London in order to be among the multitude present. Crowds approaching half a million have been known to be at Epsom on Derby day.

Across the channel from England the French in turn have taken up horse racing, and at Longchamps, near Paris, is a beautiful course where every year, a few days after the London Derby, is run another noteworthy race called the Grand Prix, or the race for the grand prize. Here gathers the fashion of Europe for the most famous day in the annual sporting calendar of Paris.

These three races, the Melbourne Cup, the Derby and the Grand Prix, contend for the honor of being the greatest race in the world. Here in America we have several which rival each other in importance in the

sporting world, among them the Futurity and Suburban at Sheephead Bay, New York, and the American Derby at Chicago, with two or three other races that might be named as of the highest interest to the lovers of the horse. These events attract more attention year after year. The American Derby, run every spring at the Washington Park race course in Chicago, has earned for its winner as much as \$49,500 in stake money. Sixty thousand persons have been present to witness the race, and the display of splendid equipages and brilliant fashion makes it noteworthy even beyond the importance of the sporting event itself.



ARMIES AND WARS OF THE WORLD TODAY

In spite of the advance of education and enlightenment, the increased facility of



BENGAL LANCERS FROM INDIA ROUTING CHINESE CAVALRY NEAR PEKIN.

communication and better acquaintance between the nations of the earth, and the progress of material affairs in this industrial age, there is little cessation in the military activities of the world. Of late years the actual hostilities between the great civilized powers have not been numerous, and yet there has been hardly a year without its war. Spain and the United States, Greece

raised up to plague them there has been hardly any interruption. Great Britain, indeed, is never at peace, and at least one London paper has a standing head line, year in and year out, "our little wars," under which general title are recorded every year, fatalities that in their total would amount to the losses of a great battle. Egypt and the Sudan, Central Africa, South



A BICYCLE BRIGADE IN THE BRITISH ARMY.

and Turkey, Great Britain and the Boers, have had their interchange of warfare. Japan and China fought over the Korean question. Various South American republics have engaged in wars, important enough to themselves and yet hardly noticed by the rest of the world.

In conflicts between the powers and the various savage or rebellious foes they have

Africa, the Afghan hills, and indeed almost every place where England's colonial efforts come in contact with native races in possession resenting innovation, are scenes of frequent outbreaks against British rule.

France, likewise, in Senegal, Dahomey, Algeria, the Sudan, Madagascar and Indo-China, has had to fight its way for colonial power. Italy first succeeded and then failed

disastrously in Abyssinia, and is now left with a fringe of barren coast on the Red Sea to show for the enormous losses of blood and treasure in the African campaigns.

Spain has seen her whole colonial possessions vanish, except a few worthless tracts at the edge of the desert in Western Africa, and from these she draws no profit. Belgium, with the Congo Free State, seems to be planning commercial development for that great tropical territory, but the end will be reached only with great labor and cost of men and money. Germany and Portugal, likewise, have Central African colonies, in every instance costing far more than they return, and even with the promise of ultimate profit there will be a long intervening period of bitter warfare with natives. Russia is constantly extending her boundaries southward, but has not yet any colonies or possessions except those of contiguous territory with the great empire itself.

We of the United States, fighting Spain to release Cuba from the yoke of oppression, found ourselves inheriting a war with the Filipinos, who were already demanding freedom from their Spanish oppressors. Within its first three years this war of ours with the Filipinos cost us immensely more in money and in men than the parent conflict with Spain itself.

So it is that all Europe, and indeed all the world, is rapidly becoming an armed camp. Nations have adopted the theory that safety can be assured only by eternal vigilance and military strength. The peace rescript of the Emperor of Russia, from which sentimentalists counted so much, was hardly circulated before there was such an outbreak of warfare as the world had not seen for many years. Great scientists and inventors are concentrating their attention upon improvements in the mechanism and



CAMEL-GUN WITH BRITISH ARMY IN THE SUDAN.

art of war. Improved rifles, projectiles and explosives of many varieties have altered the character of warfare on land almost as much as it has changed at sea. No longer are there spirited charges across open fields, or steady advances of regiment against regiment. With rifles effective at a range of one mile, and smokeless powder for the explosive, a force would be annih-

lated long before hand to hand fighting could begin. Artillery and long-distance firing, therefore, have supplemented close work with muskets. Balloons, war-kites, searchlights, machine guns, armored railway cars and other innovations have come into modern warfare. Field hospitals and ambulance systems likewise have been improved, but the happy time is not yet when the Red Cross will have no work to do, and the military organizations of the powers can release their millions of soldiers to some more profitable and productive vocation.

Some detailed information concerning the newest explosives, projectiles, guns and armies will serve to indicate the activities in this direction. Picric acid is obtained by the action of nitric acid on carbolic acid, and from it are made such remarkable destructive materials as dynamite, maximite, cordite and lyddite. The latter was the explosive most favored by the British in their campaigns against the Boers in South Africa. These high explosives, like smokeless powder, are not generally dangerous to handle. They must be prepared with detonating caps for the purpose of exploding them. The dum-dum bullet, a fatal projectile for small arms, is made of nickel, with a point of soft lead. When such a bullet strikes any object it spreads in the shape of a mushroom, making a peculiarly painful and deadly wound. They are not countenanced by the powers openly.

The various machine guns and rapid-fire guns discharge twelve to 1,500 shots a minute, according to their size and mechanism. Some of these are wholly automatic. The Maxim gun, for instance, is so arranged that after each recoil of a previous discharge the shock opens the breech, extracts the empty shell, takes a fresh cartridge,

cocks the gun, pushes the shell into its chamber and fires the gun. The cartridges are loaded into the gun in a belt, and all the operator has to do is to pull the trigger the first time and the belt is ground through the machinery at the rate of 600 shots a minute. With such explosives, projectiles and weapons in use it is apparent that warfare is becoming a more dangerous pursuit all the time. The following table shows the armed strength of the great powers:

Country.	Armies.		Navies.	
	Peace footing.	War footing.	Ships.	Men.
Austria-Hungary	361,693	2,000,000	34	18,680
France	628,755	3,250,000	124	49,755
Germany	576,666	3,000,000	77	30,386
Great Britain.....	212,449	475,000	259	114,880
Italy	825,340	3,272,409	57	25,804
Japan	157,829	603,000	32	26,108
Russia	1,100,000	4,600,000	75	39,546
United States.....	100,000		62	23,453



THE GERMAN EMPEROR'S AMERICAN YACHT

The schooner yacht Meteor, which was christened by Miss Alice Roosevelt, daughter of the President, when it was launched in New York on February 25th, 1902, in the presence of Prince Henry of Germany, is the first pleasure boat that was ever built for a European monarch in an American shipyard. The vessel from stem to stern was the product of American builders, American designers and American workmen. His Imperial Majesty, the Emperor of Germany, desired that to be the case, in order that he might feel that he possessed a genuine American product. It was not, however, the first American pleasure boat owned by Wilhelm II., who already possessed an American-built schooner, the Yampa, which he had bought some years before from its owner, who was cruising in German waters. When he ordered the Meteor he commissioned the designers of the

Yampa to build a larger schooner, with such additional improvements as have been made in the last fifteen years. Only a few months ago the materials out of which this famous little international pleasure craft was built were scattered all over the United States, from the Atlantic to the Pacific. Polished masts of white pine were growing wild in their native Oregon forests. The iron and steel in the beams and plates were unmined ore in the Pennsylvania hills. The hardwoods for the finishing of the interior were hewn by American hands in American forests; the interior appointments, the plumbing and the fittings were made by American workmen, the sails were made by American sail-makers from American canvas, and the rigging was all the work of our own countrymen. It was natural and appropriate that it should be christened by a genuine American girl, to gracefully emphasize the national character of the whole performance.

The Meteor is a large yacht, having a length over all of 160 feet, a water-line length of 120 feet, a beam of twenty-seven feet and a draught of seventeen feet. There is thus deck-room enough for a court reception. Accommodation is furnished for a crew of at least thirty men. There are two saloons, the main and the ladies' cabin, and three large staterooms, in addition to the Emperor's stacious suite. In size, indeed, the Meteor is the largest schooner-yacht ever put forth from an American shipyard. The quarters are ample, though without ostentation. The comfort of the voyagers was the point chiefly aimed at. Altogether it is a handsome craft, quite good enough for an Emperor or an American. Its cost was about \$150,000.

THE SECOND AND GREATER BROOKLYN BRIDGE

The Brooklyn Bridge is a name that has been known the world over for many a year as that of one of the most noteworthy achievements of modern times. A suspension bridge spanning the great East River and bearing the traffic of two great cities, it was indeed worthy of its high fame. But a time is coming now when the original Brooklyn Bridge will have to take a second place and be distinguished by a more specific name, for another Brooklyn Bridge is under construction that surpasses it in every way. The new bridge likewise spans the East River, connecting New York City on Manhattan Island with Brooklyn on Long Island. It is about a mile above the old bridge, and consequently will draw the great traffic from the shopping district of New York that until this time has been compelled to patronize the ferries.

The two steel towers from which the great roadway of the bridge is suspended are 1,600 feet apart, or nearly one-third of a mile. They rise to a height of 335 feet above the water, and the bridge itself is so high above the river that the masts of the largest boat may pass under it. From the tops of these great towers four steel cables, each as large as a man's body, carry a two-story platform twice as wide as a city street, with six railroad tracks, two carriage ways, two promenades and two bicycle paths. In order to attain the height over the river required for navigation, the tracks have to be carried over more than half a mile of streets and houses at each end of the bridge. The weight of the 1,600-foot span between the towers is 16,000,000 pounds, and it will carry with safety a moving load of 9,000,-

000 pounds. The steel in each tower weighs 6,000,000 pounds. The total cost of the bridge and its approaches is about \$9,000,000, and of the land about \$10,000,000 more. These figures are sufficiently eloquent to speak for themselves, and this greatest of American bridges is indeed a triumph of the builders.



HOW MAPS AND GLOBES ARE MADE

Now that the relations of the different countries of the world have become so intimate and news is transmitted so rapidly and regularly by means of the electric telegraph and distributed by the morning paper, it has become essential to have at hand for ready reference maps of all the world, in order to understand intelligently the things that are happening.

Chicago is the map making center of the country. It is said that more maps are sent out of that city annually than from all the other cities of the United States combined. Most of the railroads obtain their maps from Chicago. Hundreds of thousands of school maps are thrown off Chicago presses, and the majority of bicyclists who are ranging the country carry in their pockets Chicago-published maps made specially for them. Maps from the cheapest to the most expensive are made here, and whether cheap or expensive they follow the same path from the first drawing to the last time of going through the press. The difference comes in the size and the accuracy and care in the making which distinguishes them.

When the map publisher makes up his mind to publish a new map, one of Illinois,

for instance, he orders the draughtsmen to make an original drawing. While any mechanical or architectural draughtsman can draw a map, the number who are regarded as expert map draughtsmen is small. The draughtsman takes the map of Illinois published last, and begins his work by copying it on the scale required. That is, he copies it larger or smaller according to the number of miles that each inch on the new map will represent. A map of Illinois six feet long by four feet wide would be made on a scale of six to one; that is to say, each inch on the map would represent six miles of distance.

But the new map must be "up to date," for Americans insist that their maps must show the very latest changes in boundaries, railroads, rivers, size and importance of towns and cities, and modifications of lake shores and seacoasts. Before the draughtsman begins his work the publisher has collected from government surveys, railroad time tables, railroad maps, and county and township surveyors all the information he can find regarding changes. With this information before him the map-maker begins his work. If any dispute or uncertainty arises over any particular section, a tracing is made of the territory under dispute, and this is sent to the official surveyor of that district for correction or approval. The drawing made in india ink is of the size that the map is to be made. All the lettering is put in with the pen, but merely to indicate the place where the type must print the names of the counties, towns, etc. When the drawing is completed it is taken to the engraving-room and turned over to the map engraver.

The engraver first takes a smooth-faced copper plate of the required size, and black-

ens the face by holding it over a smoking lamp, or by painting it with lamp-black, and then covers it with a composition made of wax and gum, laying on the composition to the thickness of light blotting paper. To get the composition even, the copper plate is slightly heated, for the composition melts easily. When the plate is thus coated it is ready to receive a transfer of the drawing. The back of the paper on which the map is drawn is covered lightly with black, brown or blue chalk, and this chalked surface is laid upon the wax composition which covers the copper plate. Then the engraver, with a fine steel pencil or stylus, goes over every line and mark in the drawing. As the steel point moves over the paper the drawing is copied on the composition, just as a copy of a drawing is made with black carbon paper. The composition is white and the chalk lines stand out conspicuously.

The plate is now ready for the graver, or V-shaped tool used by the engraver. With it he goes over the chalk lines, cutting out the wax composition to the copper plate. As he first coated the plate with lamp black, he can readily see his work, because the graver leaves a black line wherever it touches the copper. The engraver does not cut out the letters. He has an easier and better way; for, setting the names up in type, he places the type in a holder somewhat like a bookbinder's stamp, and then heating the type slightly, presses them into the wax to the copper. The holder is so arranged that the type can be set up either in a curved or straight line. Perhaps there is nothing on a map which excites more curiosity and draws out more guesses than the names of the towns and cities which straddle railroad lines, curve around rivers, and appear in a badly mixed-up condition.

Every one knows that the names are printed by type, but how the type came there is a deep mystery to most persons.

When an exact copy of the drawing, with the names marked in type, is made on the plate, the engraver proceeds to "build up" the engraving. He takes a piece of the wax composition about the size and form of a lead pencil, and with a heated iron tool which looks like a piece of darning needle stuck into a handle, he builds up little mounds of wax on each side of the lines and letters. He does this to obtain the "relief," for all the time he has really been making molds in which to cast a copper electrotpe. To pour melted copper into this mold would melt the wax instantly, so the map-maker turns to electricity as the agent which will deposit the copper in his wax mold. He suspends the engraved plate or mold in a bath, after first coating the mold with graphite. Not far from it hangs a pure copper plate. To each plate he connects a wire leading from a small dynamo. The current passing from the pure copper plate to the mold, through the liquid, carries with it the copper, which is deposited in the mold, thus really making a copper cast of it. When enough copper has been deposited, the mold is taken off, the copper cast removed, and the reverse of the drawing standing out in bold relief is taken off. This thin shell is backed up with metal to make it solid and strong, and it is then ready to be placed in the press to print thousands of maps of Illinois. To engrave a map about 11 inches wide by 14 inches long requires six weeks' work of the engraver.

The electrotpe thus made is used to print the black map. For every color used in the maps, a separate plate must be made.

This explains why the price of a map increases in proportion to the number of colors used. The largest map made in one piece in Chicago is 66 inches long and 46 inches wide. Anything larger than that is made in sections, and the sections are neatly pieced together to make the whole.

Most of the maps made by or for the government are not made by the relief process, but are engraved on steel, copper, or stone. In engraving a map on steel, the steel plate is first coated with a peculiar varnish, which is acid proof. A transfer of the drawing is made on the varnish, but unlike the transfer made on the wax composition in the relief process, the copy is reversed. The engraver cuts through the varnish with his graver, and then the steel plate is placed in a bath of acid, which attacks the steel where it is not protected by the varnish. When the engraving is finished the maps are printed by the usual method of printing steel engravings.

For maps where extreme accuracy is required, as in coast surveys, soundings, and navigators' charts, a sheet of thin, transparent gelatine is placed over the drawing. With a sharp steel pencil the engraver copies the drawing into the gelatine. He then dusts blue powder over the gelatine, and the powder remains in the scratches or etching made by the steel pencil. By pressing this into the varnish the copy, in reverse, is transferred in clean, sharp lines. Engraving on copper or stone is done in much the same manner, and maps made from the stone are simply lithographed. The engraving is first made in the stone, after a copy of the drawing has been transferred to it, and then a transfer is made from the engraving to a flat stone by the lithographic process. The largest map

printed from stone is 36 inches by 62 inches. For large wall maps the sections, which pasted together on cloth make the whole, are 48 inches by 42 inches.

What was said to be the largest map ever printed was exhibited at the World's Fair. It was the map of the United States, $14\frac{1}{2}$ by $19\frac{1}{2}$ feet in size. Each inch on the map represented eighteen miles. Near it stood the electrotpe from which the map was printed. Its area covered nearly 300 square feet. It was made up of pieces so cleverly joined that the joints could not be detected.

The making of globes requires time, skill and patience. In high-class globes the sphere appears to be covered with a single piece of paper. As a matter of fact the globe is covered with twenty-four pieces, except in small globes, where half as many pieces are pasted on. The lines representing latitude on a globe appear to be straight lines. But with the exception of the equator, all the lines are curved, the curves being of such radius that when the pieces are pasted on the sphere the lines are straight.

In one map publisher's engraving-room in Chicago an engraver worked two and a half years engraving the plates for an eighteen-inch globe. He first secured a perfect sphere eighteen inches in diameter. This sphere was tested in various ways until the engraver was certain it was a true sphere. Then he divided it into twelve sections on the line of the equator, and laid it out on flat paper. Each section was cigar-shaped, curving evenly from point to point. When he cut it and pasted it on his model it wrinkled, and did not lie snugly to the bulge of the globe. He had to experiment for a time until he secured the proper

shape, width and curve for his sections, and then he laid out his map accordingly. As eight colors were to be used in printing the globe map, it required fifty-six plates before the globe could be covered.

The globes themselves are made of papier-mache. On this a coat of plaster of paris is laid, and this is turned true in a lathe. This process is used in Chicago in making all high-class globes. The greatest care must be exercised in making the globe maps, for the paper shrinks, and this shrinkage, if too pronounced, would ruin the globe. The paper is always run through the press one way. That is, the sheets are fed in exactly as they lay in the roll of paper when it came from the paper-mill. In this way the fiber of the paper always runs in the same direction in going through the press.

The largest globe made for sale is 30 inches in diameter. Until recently but few globes were made in the United States. To-day thousands of them are made and sold in Chicago alone. An 18-inch globe is now sold for about \$35; ten years ago the price of an 8-inch globe was the same as that of an 18-inch globe to-day. The cause of this great reduction in price is found in the constantly increasing demand for globes, for 100 high-grade globes are now sold to one sold ten years ago.



WATCHES AND CLOCKS

The sixteenth century inventor of the watch or spring clock would have deemed it a dream if to his Swiss soul had come a vision of the great watch factories of to-day, their thousands of employes, the division of labor, and the enormous output. Indeed, those Swiss manufacturers who

until recent years enjoyed a monopoly of the making of fine watches, can hardly realize now the extent of the industry in this country.

Those watchmaker shops of bygone days, where one or two men constructed an entire time piece, have given way to great factories where hundreds and even thousands of employes earn their daily bread. The dingy work shop has been supplanted by great factory buildings with a thousand distinct departments, well lighted and well ventilated rooms, and a complicated system centering about the superintendent's supply room, to which all parts are taken when completed, and about the factory office, which sells watches not only at home but also to the natives of Africa, to the Australian sheepmen, in short, to the inhabitants of the uttermost parts of the earth. The simple hand tools have given place to hundreds of machines, propelled by one central engine under one guiding hand.

American watches now form a great bulk of the world's entire watch production. Illinois is the seat of two of the greatest factories in the country, one at Springfield and the other at Elgin. Massachusetts has the great Waltham factory, and the work of watch making has been taken up in Ohio.

The modern watch is marvelously complex, yet marvelously simple. Its construction is merely the perfect union of a multitude of simple details. First it is necessary to separate the watch into case and works, for in spite of a popular idea to the contrary, they have no dependence upon each other. Watch works or "movements" in most American factories are manufactured in sizes ranging from number four, which is about the size of a half dollar, to

number eighteen, which is fully twice as large. Cases are made corresponding to each of these sizes, and the sizes and the cases are adapted to any make of watch. They are the product of factories established for that purpose and, of course, are of endless variety.

The movements are constructed after various plans, but in most makes they have for their foundation two plates, the lower and heavier one called the pillar plate, and the upper plate, which is often in several sections. Between these two the mechanism of the watch is arranged. The lower plate generally is of brass, the upper of nickel. They are punched from strips of sheet metal to exactly the right size and shape, after which they are smoothed and polished.

To allow room for the little wheels, indentations absolutely exact are made in the foundation plates. This work is done by a wonderful machine which follows the outlines of a steel model, made for a pattern, with absolute mechanical accuracy. The thickness of the plate and the depth of the indentations are measured so as to be perfect, according to a gauge two degrees of which equal a thousandth part of an inch. Into the plate then are drilled the necessary screw holes and apertures for the jewel settings. For every step in the process of preparing the plates there is a new smoothing and polishing given them, so that all rough edges are continually removed.

Watches containing from four to twenty-two jewels are made in most factories. The jewels used are garnets, rubies, sapphires and diamonds. Garnets are the ordinary jewels and a fifteen-jewel watch is considered the standard. The garnets are im-

ported from Coventry, England, and come in packages containing from 500 to 5,000 pairs.

The various wheels of a watch are stamped out of sheets of brass, with the exception of one or two pieces. The springs are made from sheet steel, and the screws of cold steel drawn from wire. The tempering of these various steel pieces is one of the classes of work in factories demanding highest order of skill. In tempering some varieties of screws, and some of them are so small that a glass is necessary to distinguish them from specks, the workman uses a thermometer of a peculiar sort in order that he may watch the temperature to which they are heated and then cooled at the exact point. Other varieties are tempered by watching their colors. They are heated over small furnaces until they give off light of the proper kind, and then are cooled. Screws in a watch of ordinary grade number about forty varieties, all of which are turned, sawed and gauged by girls in the factory.

The pinions, wheels, axles and similar pieces are turned out by girls. One machine cuts the pinion's length from a wire, turns it with three successive cuttings by tools which succeed one another automatically, and deposits the pinion. One girl seated on a stool which moves on rollers on a track can attend to five of these machines at once. The balance wheel, which flits back and forth with such never-varying regularity, requires forty different steps in its manufacture, simple as it appears. Steel and brass disks are brazed together, and are ground down to the required thickness. The united disk is then punched into a rim which is calculated to contain two parts of brass and one of steel.

In the edge of the rim, twenty-six holes are made, and the same number of small screws are inserted to preserve the balance of the wheel.

After the foundation plate receives its jewels and is polished, engraved and stamped with whatever ornamental design it requires, and has passed inspection together with the parts which have been adjusted to it, the whole is brought to the assembling room, where all the work of the factory comes to a successful termination. Each part has been rendered perfect. The works are adjusted, piece by piece, by fine divisions of labor, passing from hand to hand down a long row of workmen's tables in the process. Each man has his particular work and is responsible for it. When once assembled, the mechanism is tested as a whole. Thence it is taken to a refrigerator and subjected to cold. A stay in a hot-air compartment follows this, the temperature of the two tests ranging from forty degrees below zero to 103 degrees above. Not until it passes these tests without being affected is the watch considered to be perfect and ready for the market.

The dial of the watch is made by a complicated process in which a metal plate is coated with enamel, fired and glazed like china, and painted mechanically with the figures and designs before a second firing.

From the intricate details of watch manufacture it is necessary that the factory system be perfect and this necessity is met in most American factories. As a general thing the employes are comparatively well paid. The work is so specialized, however, that none of the employes become watch makers in the real sense of the word, but only skilled in their particular department. Each piece in the mech-

anism and each step in the process of manufacture is governed by fixed designs and made largely by automatic machinery, so that often an unskilled, inexperienced girl guides the machine which turns out work the most essentially exact.

The United States contains the largest clock factories of the world as well, and clocks made in this country are sold everywhere, their reputation being so high that the German and Japanese imitations, made in large numbers of late years, have actually adopted the designs and the labels of the American manufacturers, in order to obtain a share of the trade by deceiving the customer. The common spring-clocks might be called larger and rougher watches, and the processes of stamping out foundation-plates, wheels, springs and screws are not unlike those of the watch factory, modified to meet the conditions of the larger mechanism. The amazing cheapness with which watches and clocks are made, while their qualities of accuracy are preserved, is, of course, due entirely to the employment of automatic machinery which produces them in great numbers at the least cost. There is another advantage also in the fact that in machine-made pieces all the parts made by a given pattern are interchangeable, so that in the event of an accident, repairs can be made with the greatest ease and at the least expense.

Watch cases are hardly as complicated as are the works, but the factories making them are great institutions with most ingenious machinery in use. Thin sheets of metal are passed through machines which stamp out the disks of the right size, much as coins are stamped out in the mint. The disks are then passed through processes which form them to the right shape. The

polishing and engraving are done by machinery, except when some special design is made to order. The filled cases which have become such a popular substitute for the more expensive cases of solid gold, are made by welding two thin sheets of gold on opposite sides of a sheet of steel, and then stamping the disks for the case out of this combination metallic plate. A case of great strength is thus obtained at moderate cost, with a surface of gold which will wear many years without deterioration.



MIRRORS AND THEIR MANUFACTURE

In the days when society and clothing were little appreciated, some heated man, in stooping to drink from a shady forest pool, saw a face in the water. After the first superstitious fear had been overcome he doubtless came again and again, each time with greater curiosity. Perhaps he also called the attention of his wife and daughters to the phenomenon, and as soon as they discovered that their own faces looked up at them from the water, doubtless they began to think of rings for their noses. Thus vanity was born when the mirror was discovered.

Since that time mechanical skill has been engaged in making portable substitutes for the shady pool, according to the model which nature provided. First the mirror was a polished piece of metal, usually bronze, and then it was silver or brass. Everywhere the early society belle went, she carried her mirror along with her in a little box which hung from her girdle. In some cases a slave was specially employed

to keep it so highly polished that the reflection would be perfect. This use of metals continued until a comparatively recent time, and then some man who could not afford a piece of silver to look into devised a glass mirror. He found that the amount of metal required to make a thin coating on the glass was exceedingly small, and that its bright surface, being hermetically sealed by the presence of the covering glass, did not require any polishing. From that time to the present the glass mirror has prevailed, and the process of manufacturing has varied only in small details.

In the first place a mirror requires the finest kind of glass, without spot or speck or "blow-holes." The best work is done with the plate glass manufactured in St. Gobain, France, and in numerous cities of Belgium. All the largest manufacturers of mirrors use the foreign varieties in preference to those of American manufacture. The glass comes in huge plates, a quarter of an inch thick, ten or fifteen feet long, and half as broad. As many as a dozen plates are packed in a single box, displaying numerous warnings to "handle with care." When the glass is taken out it is covered with dust and bits of excelsior, and the first thing that is done is to wash it clean with water. Then a dozen of men who know just how to handle a great piece of glass without subjecting any portion of it to a breaking strain carry it into the cutting room. Here a workman in a long leather apron—usually a Frenchman who has had great experience in foreign mirror manufactories—blocks out an order on the plate, say two or three beveled mirrors for some lady's boudoir. A diamond-pointed instrument, with a strong and steady hand behind it, traces the lines of drawings on

the glass and cuts a groove so deep that the pieces easily crack out.

Each of these oval pieces is then borne into another room, filled with the humming noises of rapidly-moving machinery. A thin-faced foreign workman, with his sleeves rolled up to the elbows, and a ragged apron draping him from chin to toes, picks it up and places its edge upon the side of a swiftly revolving iron wheel. From a large wooden tank, which strongly resembles a New England ash-leach, a steady stream of sand and water flows upon the iron wheel, and in passing between it and the edge of the glass wears the bevel. The muddy water from the wheel is frequently thrown off in the swift revolutions, and works polka-dot designs all over the operator. But he is a skilled workman, and in his pride in getting the bevel on the glass exactly even—and he must depend wholly on his eye—he doesn't pay any attention to the flying mud.

When the bevel is complete it resembles "mist" or ground glass, and is full of scratches and rough places. The next workman in order smooths the bevel on a rapidly revolving emery wheel, which casts off a perfect shower of sparks. When it is as smooth as it can be made by this process it is passed to a third workman, who applies it to a fine grindstone from Newcastle, and in two minutes almost all traces of roughness have been removed. A small boy sits above the next wheel, which is made of wood, and daubs it with a wisp broom which he dips continually into a tub of water standing near at hand. He and the operator are both covered with the thin gray fluid which the wheel throws off.

By the time the wooden wheel has been used, the bevel, to the ordinary eye, looks

as smooth as the other parts of the glass. But to the trained eye of the master-workman, who has watched for flaws in the glass since he was a child, it is far from perfect, and he takes it in his hand and passes the bevel swiftly over a wheel, which is smeared with ordinary rouge, such as the actress uses to make blushes on her cheeks. It may be imagined that this part of the shop has been well treated with red—the men are all red, the floor is red, the tools are red and in passing through the department the visitor frequently acquires involuntary blushes. When the embryo mirror has passed the rouge wheel its bevel is perfect, and it is sent to an expert for inspection. If there are any remaining scratches on the glass they are marked with chalk, and a workman with an old rag smeared with rouge rubs away until it is smooth and fine.

The glass is now ready for the silvering room—a tight, hot, well-lighted apartment in which the workmen wear as little clothing as possible. An inclined plane of boards, which resembles a huge washboard turned on its side, fills one corner of the room, and on this the plates of glass are laid face downward. Over them the workman spouts a stream of water, which cleans off the dirt. Then with another hose he plays on the glass with a sensitizing solution of tin, the exact composition of which is a trade secret. The pieces of glass are next gathered up by a workman and are borne to the "bed."

While it is not provided with pillows, the "bed" is complete in almost every other particular. It has a blanket which is strung across a frame about the size of an ordinary bed, and over this a cotton sheet is stretched. Underneath, so that its surface

just touches the blanket, there is a large vat of water kept hot by steam pipes. The embryo mirrors are laid on the bed face down, and while they are yet wet with the sensitizing solution, a workman pours a diluted compound of nitrate of silver, ammonia and tartaric acid over each glass. The exact composition of this solution is also a trade secret, each firm having its own methods for mixing and each is certain that it cannot be beaten in results.

Assisted by the heat from below and by the tin solution, the silver is quickly precipitated on the glass. When the workman in charge thinks the coating is thick enough he pours off the surplus of the silver solution, and the mirror—for it is no longer in an embryo state—is put into a warm “bed” to dry off. Here another workman takes the mirror and paints the back of it with a protective solution. Each firm has a different color of paint and each paint is usually a composition differing from all the others, so that when a mirror is received for resilvering the manufacturer can usually tell just what firm originally sent it out. Frequently in special orders the backs of mirrors are covered with felt.

The whole process in the silvering-room is wasteful of silver, and many devices have been used to preserve all the metal possible. The blankets of the beds and the coverings of the tables where the nitrate of silver crystals are ground up, all go to the refineries for burning, and about 20 per cent of the silver is recovered.

The whole process of making a beveled mirror does not take to exceed an hour by the present methods, and no stage is dangerous to the workmen. When mercury and tin-foil were used a number of years ago, the fumes killed many of the opera-

tives and a mirror could not be completed under ten days.

A large mirror is much more difficult to make than a small one, owing to the difficulty of handling the somewhat fragile glass. The largest mirror ever made in Chicago—so say the manufacturers—was 18½ feet long and 8 feet broad, and it was used in a liquor saloon. Two or three of the five large manufacturers of mirrors in Chicago use French glass almost entirely, for the reason, they say, that it is much finer in quality, and lacks the greenish tint which spoils American glass for the best trade. Chicago not only supplies the home market with mirrors but ships them all over the West and to Mexico, Canada and South America.

Making plain mirrors adds about 20 per cent to the value of the plate glass, or in beveled work 30 per cent. For instance, a piece of plain French plate glass, 5x10 feet, would cost about \$75. A plain mirror of the same size would sell for \$90.



ART WORK IN BRASS

Ornamental brass work has become an important industry since banks and other business offices have taken to plate glass, mosaic floors, statuary, stained glass over desks, and other decorative luxuries. This style of brass work is but the refinement of a commoner art, and the same men who make car-fittings, valves and brass work for steam engines and other machinery, can step into an “art brass” foundry and turn out high-grade work. The brass is cast in the foundry, cleaned, pickled, buffed, spun, turned, brazed, lacquered and polished in one shop as well as in another; the dif-

ference is that finer material, daintier designs and forms and a higher finish are used in ornamental work.

The foundry is the beginning. There the brass is roughly cast to form, and from thence it starts on its way to the finishing bench. Here the alloy of copper and tin, or copper and other metals which make brass, is cast in molding sand. The operation is similar to that used in an iron foundry, particularly in an iron foundry which makes a specialty of light castings—or, as the molders call it, “snap flash” work. The brass molders work at benches—or, rather, troughs—in which is kept the molding-sand, which looks like rich black dirt and is so cohesive that when pinched between the thumb and finger the sand holds together and shows the mark of the pinch. The flask in which the sand is packed around the pattern is made of two frames, one fitting over the other. One frame has legs of wood, called dowels, and the other has holes in which these dowels fit, so that when the frames are brought together, one will remain over the other. The frames are made of four pieces of wood, fitted up with hinge-like corner-pieces, so that the frame can be unlocked and taken away from the sand without disturbing it.

The molder lays one of the frames on a smooth board which goes from one side of his bench to the other, and fills it with sand. In the center and on top of the sand he lays the pattern, and presses it into the sand, and then fits the other frame over it. He shakes over the pattern some fine “parting” sand, and then fills the upper frame with molding sand, ramming it down hard with a couple of hard wood rammers, shaped something like dumb-bells, except

that the ball on one end has a flat surface, and on the other tapers to a blunt, chisel-shaped point. After the sand is well pounded around the pattern, the molder scrapes the surplus sand from the top frame with a stick, and runs a pointed wire into the sand toward the pattern, thus providing escapes for the gases which form when the molten metal is poured in. Then he turns over both frames, or the flask, and carefully lifts the bottom frame—now the top one—from the other, exposing the pattern imbedded in the sand. The pattern is withdrawn by driving a steel pin into the wood, or, if it is a white-metal pattern, by means of a screw pin made for the purpose, and the operation is aided by gently tapping the pattern as it leaves the sand.

For hollow castings the cores are now put in place. A core is made of sand, paste and sometimes sour beer, rammed into molds and afterward baked in a large sheet-iron oven over a coke fire. Coremaking is generally done by boys, with perhaps two or three men for making the intricate cores. When the cores are laid in place in the hollow space left by the pattern, the molder scoops out his “gates,” or channels, through which the melted brass will find the mold, and then, placing the frames together, he takes off the woodwork and lays on the floor the short board with the block of sand on it. This is the way straight and core work is done. But for some purposes false core work is required, and this is, in miniature, what is done in making the mold for casting large bronze statues.

Some patterns have undercuts which cannot be molded in sand as plain patterns are. They are made with false cores, and this work requires the greatest skill in the foundry department. An ordinary core gives

form to the hollows of a casting, or makes the holes through a casting. A false core is a part of the mold built up separate from the mold proper, and as it is in small pieces it can be taken out without removing the pattern. Thus a bust can be buried in the sand, but its irregular form, its deep cuts and incurving depressions make it impossible to withdraw it from the sand without bringing part of the mold with it. The brass-molder gets around this by building up the mold out of sand packed so tight and hammered so close into the different parts of the pattern that each part can be taken away, and when the pattern is removed can be properly assembled again to form the mold. Sometimes a dozen or more pieces are required to build up a false core.

The brass is melted in crucibles, and the furnaces, usually below the floor level, are in a line, so that all the melting is done in one part of the foundry. With a pair of large tongs the crucible is lifted out of the bed and carried to the molds, and the metal is poured into the gate and thus fills the hollow in the sand. The castings which are to be polished are cleaned in water and "pickle"—acid and water—and are then buffed or burnished. Sometimes they are finished by being dipped in strong or weak solutions of nitric acid and water. For "bright dipping" the acid is strong and the brass casting is instantly withdrawn from the bath, but when a dead finish is desired the acid solution is weaker and the casting is left in until a creaming color appears on the surface. In burnishing, the brass is brought to a high finish by being rubbed with polished steel tools, or it is held against buffing wheels, which are thick, soft wheels made of cotton. Rouge,

a red polishing mixture, is put on the wheel and the high speed of the wheel polishes the brass. The buffing wheel cannot be used, however, on rough castings or irregular surfaces. The brilliancy and polish of brass which has been burnished or buffed is heightened and preserved by lacquer. This is put on the polished brass by girls, and the lacquer is dried in an oven.

Brass is spun, stamped, pressed and drawn in the same manner as copper, gold and silver, and many of the trade secrets of goldsmiths and silversmiths are shared by brassworkers.



BELLS AND HOW THEY ARE MADE

Ever since the beginning of civilization men have been called to worship by the ringing of bells. As the strand of scarlet runs through all the ropes and hawsers belonging to England's navy, so bells have marked the history of religion. Whenever the Jesuits of old established a mission, a bell was thought almost as important as a priest, and it was often brought from the foundries of Europe at great labor and expense. To many a heathen mind the clangor from the chapel belfry must have been almost synonymous with the white man's God. Even to-day, as soon as a little pine church sprouts up on a village hillside, and before the gloom of the mortgage which hangs over it has been dispelled, the "ladies' aid society" and the "young folks' helping hand" begin to raise money for a bell.

But Christians are not the only bell-devotees. The Chinese and Japanese are among the greatest bellmakers of the world,

and they have worked to the glory of Buddha or Confucius. In some ways bells have grown to be more or less a symbol of religious ceremonials.

Whether from these associations or from the fact that early castings were attended with much church ceremonial, the making of bells has something impressive about it. The manufactories are usually great, gloomy, smoky buildings, with no floor but the earth. One end is filled with the bell molds, and not farther away than the arm of a giant crane will stretch, stands the furnace in which the metal is melted.

The whole process has been reduced to a marvelously exact science. Knowing one dimension and the tone of a bell, an expert can figure out all the other measurements and the weight. In fact, the main part of bell-making is done in a clean little room where a man sits busily at work soiling clean paper with figures and drawings.

For instance, the thickness of a bell's edge is one-fifteenth of its diameter, and its height is twelve times its thickness. It must also be constructed of just the right thickness in its various parts, so that when tapped on the curve of the top it will yield a note one octave above its real key note; when tapped one-quarter of the distance from the top it will yield a note which is one-fifth of an octave, and when tapped five-eighths of the distance from the top it will yield one-third of an octave. Where the clapper strikes, all of these three will sound simultaneously, thus yielding the consonant or key note of the bell.

These are exact rules, and they have to be carefully reduced to dimensions. Besides this, the proportions of the metal to the size of the bell must be calculated. Copper and tin are used for large bells, but the

mixture varies widely, and almost every manufacturer has a rule of his own. About four parts of copper are ordinarily used with each part of tin.

When the designs have been made for a bell they go to the pattern-maker, whose haunt in his little workshop at one side of the foundry is a veritable museum of tools and patterns. The workman, after carefully making the measurements on a spruce plank, cuts out two long strips of wood, one of them just the contour of the inside of the projected bell, and the other the contour of the outside. This work must be very careful and exact. By the time it is completed the leather-aproned men at the other end of the foundry have made the basin for the mold. It is constructed in the earth, and consists mainly of firebrick and clay. At its center a stout post is planted, perfectly plumb, and just the height of the proposed bell. The two contour pieces from the pattern room are now pivoted to the post in such a way that they will swing around like the free leg of a compass.

In the center of the basin and around the post the workmen build a little furnace of brick, so large that it almost reaches the sweep of the inside contour leg of the compass. It is then pieced out on top with fire-clay, until it exactly conforms to the sweep of the contour leg. After having been made very smooth the little furnace, which is just the size of the inside of the bell, is allowed to harden for a time. This is the core. Then grease is applied and workmen again plaster on the clay until it reaches and is swept smooth by the upper contour leg. This covering of clay is exactly the size and shape of the projected bell. Any designs or inscriptions are now worked in reverse order on the "sham-bell" and plugged

in with wax. When it is dry it, in turn, is smeared with grease, and another layer of clay, called the mantle or "cope," is packed on roughly, a hole being left in the top through which the molten metal can be poured.

After having been hardened by drying for a few days the whole mass is caked by building a hot fire in the interior furnace. The wax in the inscriptions and the grease vaporize and pass off. The mantle or the mold for the outer part of the bell can now be readily grappled and lifted off. When the next layer or "sham-bell" is removed and the mantle replaced the space left between it and the core furnishes the bell-mold. Little holes are left in the bottom of the mold for the escape of gas during the pouring. Everything is now ready for the greatest event of the whole process.

In the furnace the great mass of bell-metal is already bubbling away, as liquid as water, and the furnace-stokers below are perspiring with their exertions. Outside and at a safe distance stand the spectators, with the glare of light from the furnace reddening their faces.

Then the master-workman, calm and slow-voiced in spite of his anxiety and responsibility, steps forward and waves his hand. Instantly the throat of the furnace opens and a molten stream of metal, hissing and spitting, gurgles out into a great earthen crucible. As it reaches the bottom, which has been previously littered with charcoal, a great burst of green flame spurts a score of feet into the air. The whole effect is indescribably gorgeous. The faces and the bare, brawny shoulders of the workmen gleam pale against the smoky sides of the furnace. The grimy rafters overhead send back the shower of sparks, and even

the glowing mouth of the furnace pales before the brilliancy of the flame. The men rush forward and throw small pieces of broken bells into the crucible to cool the metal a little, and they are melted like icicles in a cauldron of boiling water.

It takes great skill to tell just when the molten metal is of the right temperature to pour. When this moment has arrived the huge arm of the crane reaches forward and lifts the crucible in the air and swings it out until it is just over the mold. Then there is a pause. The visitors are silent, holding their breaths, and the workmen, like the hunter who pauses with game in view and his finger on the trigger, stand motionless, their eyes intently fixed on the glowing crucible suspended high above them.

The work of weeks may be completed beautifully or ruined in an instant. It is like the supreme moment in a tragedy.

Then the heavy silence is broken by the master's voice, and the crucible is slowly tipped and its molten contents stream downward into the mold. A man stands near igniting the gas, which belches out as the metal goes in. If it is not destroyed it may leave blowholes in the bell, thus rendering it useless. At last the metal overflows the mouth of the mold and then the crucible is tipped back. The pouring is complete.

Then the mold is left for several weeks to grow cold and shrink, because if broken open at once the bell would cool more rapidly on the outside than on the inside, and would burst. The moment of breaking off the clay mantle is also one of anxiety. It discloses whether or not the work has been successful.

When entirely extricated and still in its

"maiden state," as it is called, the bell is tested, and if it gives out a single pure tone it is regarded as a perfect cast. The manufactory which can turn out the largest proportion of "maiden" bells is the most successful. If the tone is not pure the bell can sometimes be tuned by filing away the parts of the inside surface, but it can never be made equal to a "maiden."

The largest bell ever cast was the celebrated "king of bells," as it is called by the Russians, in Moscow. It was made under the orders of the Empress Anne in 1733, and at the time of its casting a great religious ceremony was held, during which hundreds of nobles threw their silver and gold jewelry into the furnace. The bell measures 22 feet 8 inches across the mouth, 19 feet 3 inches in height and its thickness at the base, where the clapper would strike, is 23 inches. Its estimated weight is from 400,000 to 440,000 pounds. A nearly triangular piece of metal about 6 feet high and 7 feet across the base, weighing 11 tons, is broken out from the rim. There has been much discussion as to whether it was ever rung or not. Be that as it may, the bell now stands within the Kremlin, where it was originally placed, to serve as a chapel for religious exercises. Its value on account of the gold and silver which it contains is said to be very great.

The largest bell in America is in the cathedral of Montreal. Its weight is 28,000 pounds. The old "liberty bell," which rang when the Declaration of Independence was signed, weighs only 1,500 pounds. Early Chinese bells were nearly square, and were welded out of different pieces.

The Mexicans make bells out of clay, baked like pottery, in the form of women, arms, head and skirts.

HOW ARTESIAN WELLS ARE BORED

Artesian wells are changing some of the dry, arid tracts of the west into the best farming lands of the country. The water brought sometimes a thousand feet from under the surface, is conveyed, by irrigating ditches, to the parched earth, rich in all that goes with good producing soil except water, and when that great need has been supplied abundant crops will result. In large cities, equipped with extensive and modern waterworks systems, thousands of artesian wells supply industrial plants with water, and in the long run save thousands of dollars of water taxes to the manufacturers.

In some wells the pressure of water is sufficient to send it to the surface, but from the majority of wells the water is pumped by steam pumps or windmills. The man who bores an artesian well works under a great disadvantage, for he is in the dark as soon as his boring and driving tool is well under the surface of the ground. His drill points, casing, rods, sand pump, reamer or any one of the dozen tools and appliances he uses, may be broken hundreds of feet under ground, but he goes to work to extract the broken tool or dislodge the piece that is stuck as calmly as though it were just at hand.

The ingenious devices used by the well borer for repairing damage and overcoming obstacles, are the result of the hard, exasperating, practical, expensive experience of hundreds of well borers for many years. The business of boring artesian wells, drive wells, oil, gas and other wells made by sinking a line of pipe, has developed into a distinct branch of hydraulic

engineering, for water is one of the most important tools used by the up-to-date well borer. In fact, some holes are literally pumped out, and the pipe casing sinks into the ground without a blow or a shove.

In driving a tube well on a farm either a horse-power machine or a portable steam engine is used as power. A hole is bored for some distance and this hole is cased with an iron pipe which is driven into it. The well-driving apparatus consists of a drill screwed to the bottom of the drill rod, which is in sections, so that the rod can be lengthened by screwing sections together.

The drill rods are made of iron pipe, and every thirty feet or so in the hollow drill rod is a valve which opens from beneath. In the drill is a hole, and as the drill is lifted and dropped alternately by the mechanism on the ground, water is poured into the well. This makes a "slush" of the pounded, crushed earth, clay, gravel or stone, and it enters the drill rod through the hole in the drill.

When the drill is lifted, of course the rods, with the water and slush in them, are raised. The drill is dropped suddenly, and as the heavy iron and steel falls more rapidly than the slush and water, the slush passes into the next section above through a valve, which closes when the drill is again raised. In this manner the drillings are lifted to the surface and are there discharged.

The drill is lifted and dropped, crushing its way deeper and deeper into the earth, and as it sinks the iron casing is driven down after it. A pump is always attached to the head of the apparatus, and when water is reached the pump is started, and the sand in the gravel bed is pumped

out, forming a reservoir in the clean gravel. This method of sinking a well is rapid and inexpensive.

An improvement on this is the "rolling" and "jetting" process. This is a combination of the principles of hydraulic mining, as practiced in California, and of the diamond drill without the diamonds. In hydraulic mining a stream of water, forced from the nozzle at a great pressure, is directed against the bank, and the earth is washed away just as furrows are cut into the sod on a lawn by the jet of water from a garden hose.

A diamond drill cuts its way into the earth, clay and rock, by revolving a drill-point studded with black diamonds. In the rolling and jetting system used in sinking artesian wells, the cutter is a section of pipe on the lower end of which teeth are cut. As this is revolved in the ground by the machine which grips the pipe and turns it, jets of water are forced down inside of the pipe. The water rushes out from under the cutter's teeth and returns to the surface of the ground on the outside of the pipe. This returning water cushion between the pipe and the earth lessens the friction and gives the casing an easy rotation.

Naturally the hollow cutter carries a core of the material through which it forces its way, and the well-borer utilizes this core, if it be of clay, to build up a clay wall for the bore when it passes through quicksand. If there be not enough clay in the core for this purpose, he puts some in the pipe, and the water carries it down and up, packing it in the quicksand. If a material is met which the cutter finds difficulty in boring, broken emery rock, iron ore, flint sand and other abrasives are sent down through the

pipe. For material too hard to be cut by the steel cutter, a cutter set with black diamonds is used. A modification of this hydraulic-cutting combination is a steel "paddy" drill, which is carried down with the casing and cutter. This apparatus permits the use of all the appliances without taking out or letting down other tools. A drill is attached to the end of a hollow drill rod which goes down inside of the casing. The rod and casing have independent movements, so that the drill can work ahead of the casing, or the casing can cut its way without the drill, both of them aided by the water sent down from above.

Enormous augers which bore holes from eight to thirty inches in diameter are used to sink shallow wells. It is conceded that wells more than 60 feet deep should be bored with the well-driving machinery and not with earth augers. The huge auger is fixed to the lower end of a vertical shaft, which is connected with the proper mechanism to twist it around. In the use of horse power the auger shaft is attached to the sweep to which the horse is hitched. Some of the augers are real augers, others are bucket-shaped, with cutting edges, and still others are claw-shaped, but they all cut out the hole, and when full of earth are lifted to the surface, emptied and sent down to corkscrew their way deeper.

Such wells are cased with vitrified, glazed or terracotta tiling, galvanized pipe, etc. If the auger, which is not made for stone work, meets a rock or a boulder, a drill is sent down the hole and the rock is broken or bored through. If it is a loose stone it is lifted from the hole, provided it is not too large for the bore, by "screw tongs," "ram's-horn" rock extractors and other devices of like nature.

A sand pump is a hollow cylinder of iron, fitted with a hinged bottom which opens inside of the cylinder. When it is dropped into the sand the door is forced up and the sand, when inside, holds it closed so that the material can be lifted out.



DISCOVERIES IN MEDICINE AND THE PROLONGATION OF LIFE

Dr. John Pot came to Virginia in 1610, and Dr. Samuel Fuller came over in the Mayflower in 1620. They have the distinction of being the first white "medicine men" within the present limits of the United States. An attentive schoolboy twelve years of age doubtless now knows as much of the genuine principles of health as they did, and he is a dull student if he does not know a great deal more of the structure of the body.

At the close of the Revolutionary War there were about 3,500 medical practitioners in the United States, and only about 400 of these had graduated from any school of medicine. There were then only two medical colleges in this country, and they had conferred only 51 degrees. So few people patronized the doctor that usually he made his living at some other work and practiced medicine as a pastime.

The theory and practice of medicine have since then advanced to a high position among the sciences by the aid of important discoveries made in kindred sciences. The sufferings of the human race have been decreased more than can be estimated, and the happiness of mankind has been advanced in proportion through medical investigation and prophylactic discoveries with their allied sciences. A few of the

more important general discoveries may be thus mentioned:

Lady Mary Montagu brought the knowledge of inoculation against smallpox from Constantinople, and Dr. Jenner, in 1798, taking it up as a scientific matter, brought

age died, while more than half of the others were left badly disfigured. In contrast, the greatest epidemic of smallpox in the nineteenth century, that of 1872 and 1873, attacked less than five per cent in any city. In Germany, where vaccination is rigidly



LABORATORY WORK IN A MEDICAL COLLEGE.

vaccination into general use. In Europe, previous to the introduction of this preventive, at frequent intervals, from one-fourth to one-half of the population of the great cities were attacked by smallpox and 95 per cent of the children under ten years of

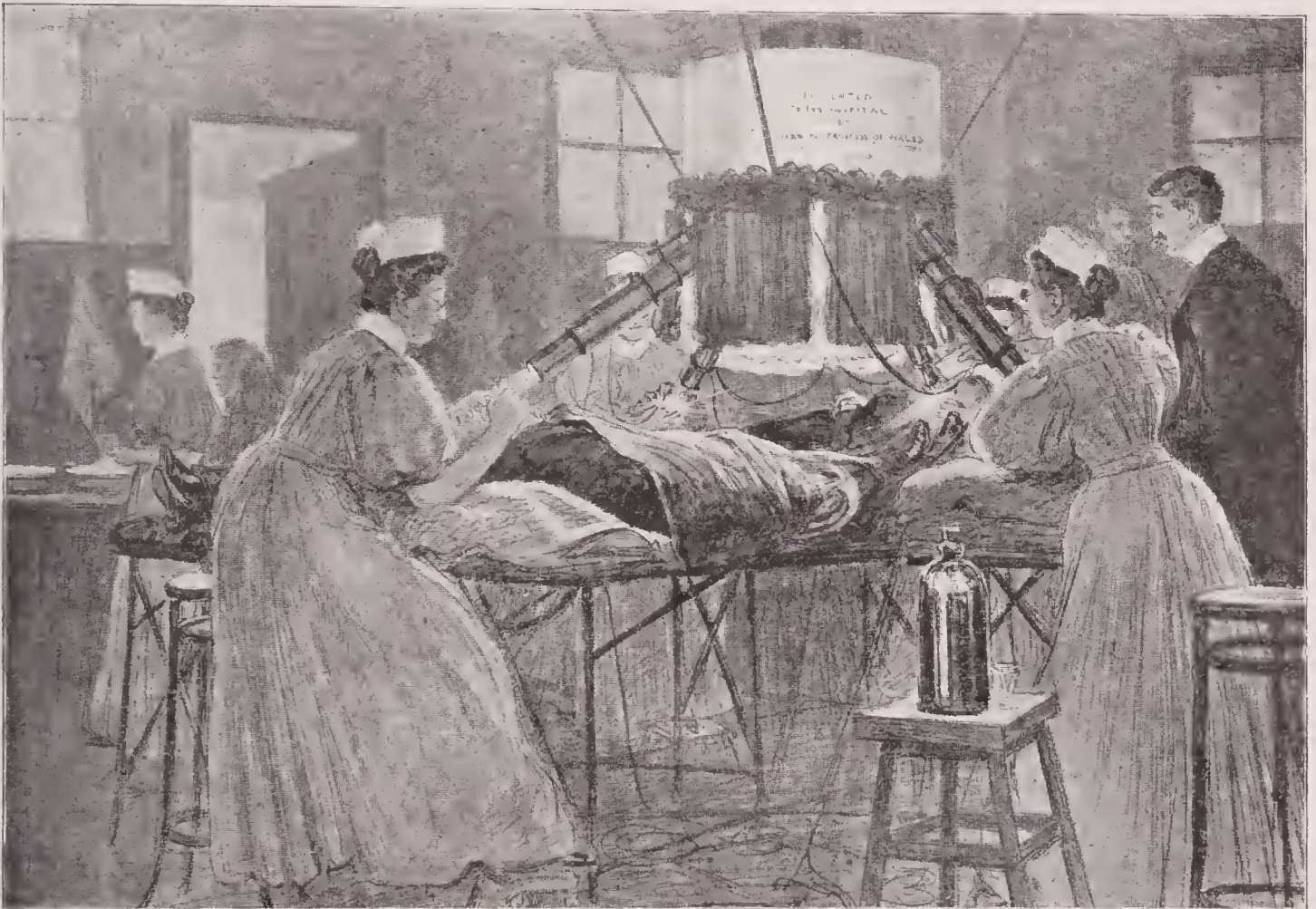
required, the deaths from smallpox are less than one-tenth of those of the surrounding countries, where vaccination is not thoroughly done.

Auscultation, or listening to the sounds produced in the chest by the heart and

lungs, as invented by Laennec in 1819, revolutionized the treatment of diseases of the internal organs of the body.

Dr. J. Y. Simpson of Connecticut made the greatest discovery of the nineteenth century in its application to surgery, by

The minor discoveries that alone would mark an epoch in almost any science, such as antitoxin, which has reduced the mortality from diphtheria fully 95 per cent, with the discoveries of Pasteur and Koch to avert hydrophobia and tuberculosis, are



APPLICATION OF THE LIGHT CURE IN A LONDON HOSPITAL.

making practical the use of drugs to deaden pain. Anesthetics thus did away with the horrors of surgical operations on suffering human beings.

Chemical cleanliness from all destructive germs in surgical work is the result of the discoveries of Joseph Lister of England. It is estimated that through his discoveries in the use of antiseptics the death rate from infections of wounds has been decreased at least one-half.

too numerous to mention except in an extended treatise on the subject.



SPECIAL CULTS AND CURES

Innumerable specifics have meanwhile become popular, to contribute to general practice whatever they contained of value, and then fall into disuse.

The food cure is an exclusive diet of milk, grapes, and farinaceous vegetables

during any period of disturbance in health.

The earth cure consists in immersing the body in mud or dry earth during periods of soreness or pain.

The water cure is the use of water at different temperatures either in immersion, douches in solid streams, or by the body being packed in wet sheets. The steam or hot air baths are used in the same connection, with vigorous rubbing with coarse towels.

The air cure, for rheumatism, paralysis, and similar diseases, is also known as the vacuum treatment. It is given by manipulating the limbs or parts of the body under or with vacuum pumps or disks.

The oxygen or ozone cure requires the patient suffering debilitation or lung troubles to live in an atmosphere specially prepared for him in an air-tight room or by the use of special inhalers.

The cure from sun-air baths is applied by exposure of the skin to the direct rays of the sun in dry, still air.

Breathing methods require certain periods each day of deep chest expansion where the air, if possible, is dry and pure.

Cures by electricity are effected by keeping the diseased parts directly in a current of electricity as powerful as may not be painful, for a given time.

The movement cure is a mechanical assistance given to the vital forces known as voluntary and involuntary. It is claimed that a violent agitation of parts that are in a state of torpor arouses and stimulates the circulation through them, both of blood and nervous force. Machinery is used to give vibration, which is said to produce heat and consequent development of energy in the parts.

The lift cure is accomplished by the

action of standing erect, knees bent three or four inches, upon a platform resting on spiral springs. The lifter grasps a cross bar connected with the springs, adjusted by weights. The operation is in straightening the bent knees, while otherwise remaining erect, thus lifting the weight, and breathing deeply and rhythmically with each movement.

Mind cures, faith cures, and the like, consist in mentally separating one's self from the disease and giving it no place in the system.

The rest cure is self-explanatory as to treatment. It consists of a complete cessation of mental and physical action for given periods under the most comfortable conditions, or as isolated as possible from all disturbance. The latter has been called the wilderness cure.



SYSTEMS OF MEDICAL TREATMENT

Hahnemann, when he invented Homeopathy, on the principle that like cures like, gave the name Allopathy to the earlier school that cured on the theory of revulsion, that is of substituting one disease for another, as practiced by Paracelsus; and he also gave the name Enantiopathy to the doctrine that a thing is destroyed by its contraries, as practiced by Galen.

Hydrotherapy was the name given later to the school which effected its cures by the various uses of water, as practiced by the Rosicrucians.

The Eclectic school, as the name suggests, claims to take the best from all systems, but it relied mainly in the beginning on decoctions and extracts of herbs.

Osteopathy has firmly established itself in many places, and depends for its cures on the manipulation of the bony structures of the body. There are numerous minor systems, but the great discoveries of the last few years have almost completely obliterated the former dividing lines of the older medical schools. Physicians, like other thinking men, are becoming more tolerant

ELEMENTS OF PHYSICAL HEALTH

The assertion made for so many generations that cleanliness is next to godliness may not be as persuasive as if we were to say that cleanliness is the first law of health and long life. That many persons have attained extreme old age without regard to



OPERATING ROOM IN A GREAT DENTAL COLLEGE.

of varying opinions and methods. The best of them frankly admit that good is found in all schools of practice, and are glad to make use of whatever discoveries aid in the healing of bodily ills and infirmities. So the entire body of medical men, in the highest sense of the phrase are becoming eclectic. No longer do they refuse to consult with their rivals, and the public thus is permitted the benefits of all progress.

cleanliness is not very weighty proof that cleanliness is not one of the most goodly assistants to longevity.

Since there are 2,800 outlets to the square inch all over the body, making a personal sewage system of twenty-eight miles of pipes, this effort of nature to get rid of its waste matter should be fully sustained by baths and clean clothing. Fifteen minutes is long enough for any bath, and the water

should be warm, tepid or cold, according as the person may find it most enjoyable and beneficial. No absolute rule can apply to all persons and all conditions.

During fatigue and while the stomach is digesting food, there should be no disturbance of the temperature of the skin, nor should a bath be taken within an hour or two after a meal.

Nothing quickens the functions of the body in a more harmonious manner than suitable exercise. It should always stop short of fatigue, and never extend to violence. Exercise of a general nature equalizes the circulation and aids the assimilation of nutriment. It prevents congestions and torpor of all kinds. It is thus of animating service to the mind, and may be regarded as the most important element in the promotion of long life.

Sleep is rest, and rest is the necessary alternate in all energy. Comfort is the first condition of sleep, after the suspension of action and thought. Sleep is the most restorative when it is the most complete suspension of all energy within body and brain. By systematic practice one can thus compose the mind at will and the healthy person should be able to fall asleep within five minutes of the first attempt. Cessation of thought without sleep may even become complete enough to be complete cessation of image-making, and therefore a fully unobstructed rest.

One who has a natural appetite and a normal organism, should never swallow anything that is in any way distasteful, nor should he ever impose any labor upon digestion that should be performed by mastication.

Usually in any derangement of the system, and most derangements come from

some torpidity in the digestive organs, the first effect is a disinclination toward food. This is nature's warning that the digestive apparatus is in no condition to do its work and the warning should be heeded.

The organs that take up the nutriment from the food can only use so much, and an excessive quantity of food only dulls their vitality. In times of famine those die of starvation first who have been the heaviest eaters. Those whose habit it has been to eat little can extract more nourishment from the food eaten than the others are able to do, and so suffer less.



THE PULSE IN HEALTH

The frequency of the pulse varies slightly according to temperaments, but the following is regarded as the average:

New born infants from.....	140	to	130
During first year, from.....	130	"	115
During second year, from.....	115	"	100
From seventh to fourteenth year,			
from	90	"	85
From fourteenth to twenty-first year,			
from	85	"	75
From twenty-first to sixtieth year,			
from	75	"	70
In old age, from	70	"	60



CONTAGIOUS AND ERUPTIVE DISEASES

It will often relieve a mother's anxiety to know how long after a child has been exposed to a contagious disease there is danger that the disease has been contracted. The following table gives the *period of incubation* — or anxious period — and other

information concerning the more important diseases:

Disease.	Symptoms usually appear with-	Patient is Infectious.
Chicken-pox...	14 days in.	Until all scabs have fallen off.
Diphtheria....	2 "	14 days after disappearance of membrane.
Measles.....	14 "	*Until scaling and cough have ceased.
Mumps.....	10-22 "	14 days from commencement.
Rötheln.....	14 "	10-14 days from commencement.
Scarlet fever.	4 "	Until all scaling has ceased.
Small-pox....	12-17 "	Until all scabs have fallen off.
Typhoid fever	11 "	Until diarrhœa ceases
Whooping cough.....	14 "	†Six weeks from beginning to whoop.

*In measles the patient is infectious three days before the eruption appears.

†In whooping-cough the patient is infectious during the primary cough which may be three weeks before the whooping begins.



FIRST AID TO THE INJURED— WHAT TO DO IN EMERGENCIES

Drowning. 1. Loosen clothing, if any. 2. Empty lungs of water by laying body on its stomach and lifting it by the middle so that the head hangs down. Jerk the body a few times. 3. Pull tongue forward, using handkerchief, or pin with string, if necessary. 4. Imitate motion of respiration by alternately compressing and expanding the lower ribs about twenty times a minute. Alternately raising and lowering the arms from the sides up above the head will stimulate the action of the lungs. Let it be done gently but persistently. 5. Apply warmth and friction to extremities. 6. By holding tongue forward, closing the nostrils and pressing the "Adam's apple" back (so as to close entrance to stomach),

direct inflation can be tried. Take a deep breath and breathe it forcibly into the mouth of patient, compress the chest to expell the air and repeat the operation. 7. *Don't give up!* People have been saved after hours of patient, vigorous effort. 8. When breathing begins take patient into a warm bed, give warm drinks, or spirits in teaspoonfuls, fresh air and quiet.

Burns and Scalds. Cover with cooking soda and lay wet cloths over it. Whites of eggs and olive oil. Olive or linseed oil, plain, or mixed with chalk or whiting.

Lightning. Dash cold water over a person struck.

Sunstroke. Loosen clothing. Get patient into shade, and apply ice-cold water to head.

Mad Dog or Snake Bite. Tie cord tight above wound. Suck the wound and cauterize with caustic or white-hot iron at once, or cut out adjoining parts with a sharp knife.

Venomous Insects' Stings, etc. Apply weak ammonia, oil, salt water or iodine.

Fainting. Place flat on back; allow fresh air and sprinkle with water.

Tests of Death. Hold mirror to mouth. If living, moisture will gather. Push pin into flesh. If dead the hole will remain, if alive it will close up.

Cinders in the Eye. Roll soft paper up like a lamp lighter and wet the tip to remove, or use a medicine dropper to draw it out. Rub the other eye.



ANTIDOTES FOR POISONS

First. Send for a physician.

Second. Induce vomiting, by tickling throat with feather or finger. Drink hot water or strong mustard and water. Swallow sweet oil or whites of eggs.

Acids are antidote for alkalies, and vice versa.



SPECIAL POISONS AND ANTIDOTES

Acids, muriatic, oxalic, acetic, sulphuric (oil of vitriol), *nitric* (aqua-fortis). Soap-suds, magnesia, lime-water.

Prussic acid. Ammonia in water. Dash water in face.

Carbolic acid. Flour and water, mucilaginous drinks.

Alkalies. Such as potash, lye, hartshorn, ammonia. Vinegar or lemon juice in water.

Arsenic, rat poison, paris green. Milk, raw eggs, sweet oil, lime-water, flour and water.

Bug poison, lead, saltpetre, corrosive sublimate, sugar of lead, blue vitriol. Whites of eggs or milk in large doses.

Chloroform, chloral, ether. Dash cold water on head and chest. Artificial respiration. Piece of ice in rectum. No chemical antidote.

Carbonate of soda, copperas, cobalt. Soap-suds and mucilaginous drinks.

Iodine, antimony, tartar emetic. Starch and water. Astringent infusions. Strong tea, tannin.

Mercury and its salts. Whites of eggs, milk, mucilages.

Nitrate of silver, lunar caustic. Salt and water.

Opium, morphine, laudanum, paregoric, soothing powders, or syrups. Strong coffee, hot bath. Keep awake and moving at any cost.

Strychnine, tincture of nux vomica. Mustard and water, sulphate of zinc. Absolute quiet. Plug the ears.

RULES IN CASE OF FIRE

Crawl on the floor. The clearest air is the lowest in the room. Cover head with woolen wrap, wet if possible. Cut holes for the eyes. Don't get excited.

Ex-Chief Hugh Bonner, of the New York Fire Department, gives the following rules applying to houses, flats, hotels, etc.:

Familiarize yourself with the location of hall windows and natural escapes. Learn the location of exits to roofs of adjoining buildings. Learn the position of all stairways, particularly the top landing and scuttle to the roof. Should you hear a cry of "fire," and columns of smoke fill the rooms, above all *keep cool*. Keep the doors of rooms shut. Open windows from the top. Wet a towel, stuff it in the mouth, breathe through it instead of nose, so as not to inhale smoke. Stand at window and get benefit of outside air. If room fills with smoke keep close to floor and crawl along by the wall to the window.

Do not jump unless the blaze behind is scorching you. Do not even then if the firemen with scaling ladders are coming up the building or are near. Never go to the roof, unless as a last resort and you know there is escape from it to adjoining buildings. In big buildings fire always goes to the top. Do not jump through flame within a building without first covering the head with a blanket or heavy clothing and gauging the distance. Don't get excited; try to recall the means of exit, and if any firemen are in sight *don't jump*.

If the doors of each apartment, especially in the lower part of the house, were closed every night before the occupants retired there would not be such a rapid spread of flames.

ACCIDENTS IN THE UNITED STATES

In 1900 there were 2,550 railway employes killed and 39,643 injured; there were 249 passengers killed and 4,128 injured; in other accidents 5,066 persons were killed and 6,549 injured, so that the total casualties for the year were 7,865 and 50,320 respectively.



LIFE AND DEATH RATES

This table shows how many out of 10,000 persons die annually at each year up to 104. It is used by all life insurance companies in their computations of risk, premiums, etc.

Year.	No. Alive.	No. Deaths.	Year.	No. Alive.	No. Deaths.
At birth		1,539	35.....	5,362	55
1.....	8,461	682	36.....	5,307	56
2.....	7,779	505	37.....	5,251	57
3.....	7,274	276	38.....	5,194	58
4.....	6,998	201	39.....	5,136	61
5.....	6,797	121	40.....	5,075	66
6.....	6,676	82	41.....	5,009	69
7.....	6,594	58	42.....	4,940	71
8.....	6,536	43	43.....	4,869	71
9.....	6,493	33	44.....	4,798	71
10.....	6,460	29	45.....	4,727	70
11.....	6,431	31	46.....	4,657	69
12.....	6,400	32	47.....	4,588	67
13.....	6,368	33	48.....	4,521	63
14.....	6,335	35	49.....	4,458	61
15.....	6,300	39	50.....	4,397	59
16.....	6,261	42	51.....	4,338	62
17.....	6,219	43	52.....	4,276	65
18.....	6,176	43	53.....	4,211	68
19.....	6,133	43	54.....	4,143	70
20.....	6,090	43	55.....	4,073	73
21.....	6,047	42	56.....	4,000	76
22.....	6,005	42	57.....	3,924	82
23.....	5,963	42	58.....	3,842	93
24.....	5,921	42	59.....	3,749	106
25.....	5,879	43	60.....	3,633	122
26.....	5,836	43	61.....	3,521	126
27.....	5,793	45	62.....	3,395	127
28.....	5,748	50	63.....	3,268	125
29.....	5,698	56	64.....	3,143	125
30.....	5,642	57	65.....	3,018	124
31.....	5,585	57	66.....	2,894	123
32.....	5,528	56	67.....	2,771	123
33.....	5,472	55	68.....	2,648	123
34.....	5,417	55	69.....	2,525	124

Year.	No. Alive.	No. Deaths.	Year.	No. Alive.	No. Deaths.
70.....	2,401	124	88.....	232	51
71.....	2,277	134	89.....	181	39
72.....	2,143	146	90.....	142	37
73.....	1,997	156	91.....	105	30
74.....	1,841	166	92.....	75	21
75.....	1,675	160	93.....	54	14
76.....	1,515	156	94.....	40	10
77.....	1,359	146	95.....	30	7
78.....	1,213	132	96.....	23	5
79.....	1,081	128	97.....	18	4
80.....	953	116	98.....	14	3
81.....	837	112	99.....	11	2
82.....	725	102	100.....	9	2
83.....	623	94	101.....	7	2
84.....	529	84	102.....	5	2
85.....	445	78	103.....	3	2
86.....	367	71	104.....	1	1
87.....	296	64			



CREMATION

The burning to ashes of the bodies of the dead is one of the most ancient of customs, in all countries which have had an ancient civilization. The prejudice against cremation is but one Jewish influence among the many influences that through the scriptures have had such a powerful effect upon the feelings and habits of the civilized world.

The poems of Homer show that the custom of burning the dead was common during the Trojan war, more than a thousand years before Christ. Almost every country having a long history has, one time or another in its career, very generally practiced cremation. Evidences show that it has usually partaken of a religious character.

The use of the tomb was forever hal- lowed among Christians by the method of Christ's burial. The belief in the resur- rection of the material body from the grave caused cremation to be looked upon with abhorrence among all those who held to that doctrine.

The cremation of the body of the poet Shelley and that of his friend Williams.

in 1822, drew forth a general discussion of the subject, especially among the learned men of Germany and Italy.

In 1874 the closed receptacle was first used, and the second person to be cremated therein was the wife of Sir Charles Dilke, in Dresden.

In 1878, through the efforts of Sir Henry Thompson, the first crematory in England was built at Woking, in Surrey. However, it was four years before there was a cremation and that was done privately. In 1884 England declared it was a legal process of disposal of the dead.

The first crematory in the United States was built by Dr. Le Moyne, at Washington, Pa., in which the first cremation was that of Baron de Palm. Cremation societies for the erection and maintenance of crematories now exist in nearly every large city in the world, and many distinguished persons have recently selected that process for the disposal of their remains.

In 1900, at the Fresh Pond Crematory of New York City, there were 602 bodies cremated. Nearly 4,000 have been cremated at that place. Other places of cremation show a like increase of patronage, and the custom has virtually ceased to arouse comment.

The method of the process is simple, and without any specially harrowing conditions. The furnace is raised to a high degree of heat before the body in the closed receiver is introduced, when the door is closed and the heated air and gas turned in. It requires about half an hour to complete the process, when the wholly oxidized vapors of the body have passed into the air through a high chimney, and the remaining ashes for an adult weigh from five to seven pounds. The cost is about \$25, and

would be one-tenth of that sum if the custom was general.

The main reasons urged in favor of this method of disposal of the dead are its cleanliness, speed and sanitary results. Opposed to it are the religious ideas of a material resurrection and that it destroys all evidences of crime upon the body. To the first, the answer is given that this method is nowhere forbidden in scripture, and that all things are possible with God; to the other, that more crimes would thereby be detected because of the scientific examination of every body offered for cremation.



LEGAL FACTS AND FORMS

POWER OF ATTORNEY.

Sometimes it is desirable for one who is to be absent from home to empower some one else to act for him and sign his name. The legal document conferring that authority is called a power of attorney. Such an instrument should be drawn with the utmost exactitude, for it is a very important grant, especially if it be general in character. Here is a form, with a variation for general or special power indicated:

Know all men by these presents, That I, John Jones, of the City of Chicago, County of Cook, State of Illinois, have made, constituted and appointed, and by these presents do make, constitute and appoint, Henry Harris true and lawful attorney for me and in my name, place and stead, to lease, sell or make any other disposition whatever of any of my property in said city, [or certain specified property] and to sign, seal and deliver any agreement, assignment, assurance, conveyance or lease to any person who shall purchase, or agree to pur-

chase, such property, or any part thereof, and in due form of law to acknowledge any such instrument necessary to the proper conveying or leasing said premises, or any part thereof, giving and granting unto my said attorney full power and authority to do and perform all and every act and thing whatsoever, requisite and necessary to be done in and about the premises, as fully to all intents and purposes as I might or could do if personally present, with all power of substitution and revocation, hereby ratifying and confirming all that my said attorney or his substitute shall lawfully do or cause to be done by virtue hereof.

In Witness Whereof, I have hereunto set my hand and seal the 2d day of June, nineteen hundred and two.

JOHN JONES [SEAL]

Signed, sealed and delivered in the presence of JOHN MARTIN, Notary Public.

AFFIDAVITS AND DEPOSITIONS.

An affidavit is a written statement sworn to or affirmed by the person making the statement, before a qualified officer.

A deposition is the testimony of a witness under oath, reduced to writing, and subscribed to before a qualified officer.

BILLS OF SALE.

Bills of sale are written evidences of agreements by which parties transfer to others, for a consideration, all their right, title and interest in personal property.

The ownership of personal property, in law, is considered changed by the delivery of such property to the purchaser; though in some states, without delivery, a bill of sale is good evidence of ownership, even against creditors, provided the sale was not fraudulently made for the purpose of avoiding the payment of debts.

Juries have power to determine the fairness or unfairness of a sale, and upon evidence of fraud such bill of sale will be ignored and declared void.

Any form of words, importing that the seller transfers to the buyer the title to personal property, is a bill of sale.

FORMS OF DEEDS.

The forms of deeds conveying lands are prescribed by several states, and such forms should be generally used. The requisites of a valid deed are: Competent parties; consideration; the deed must be reduced to writing; it must be duly executed and delivered. The mode and effect of an acknowledgment or of a deed is governed by the law of the state where the land lies, and not by that of the place where the acknowledgment is taken. Where the deed is executed by an attorney in fact, it is customary to have the power of attorney acknowledged by the principal and the deed acknowledged by the attorney. A deed executed by several grantors should be acknowledged by each of them.

WILLS.

All persons are competent to make a will except idiots, persons of unsound mind, and infants. In many states a will of an unmarried woman is deemed revoked by her subsequent marriage. A nuncupative or unwritten will is one made by a soldier in active service, or by a mariner while at sea.

In most of the states a will must be in writing, signed by the testator, or by some person in his presence, and by his direction, and attested by witnesses, who must subscribe their names thereto in the presence of the testator. The form of wording a will is immaterial as long as its intent is clear.

Age at which persons may make wills is

in most of the states 21 years. Males and females are competent to make wills at 18 years in the following states: California, Connecticut, Hawaiian Islands, Idaho, Montana, Nevada, North Dakota, Oklahoma Territory, South Dakota, Utah; and in the following states only females at 18 years: Colorado, District of Columbia, Illinois, Maryland, Missouri, Wisconsin.

DUE BILLS.

A due bill is not negotiable paper, so can not be legally assigned. It is, however, a memorandum of indebtedness, and may be made the subject of an order. Sometimes a due bill is made to take the form of a note, by being made payable one day after date, or on order. To be a true due bill, in due form, it should merely state that there is a given amount in money or goods due this day to the holder.

ORDERS FOR GOODS OR MONEY.

Ordinary orders are a matter of mutual convenience, running much as follows:

\$60 CHICAGO, May 10, 1902.

Messrs. Marshall Field & Co.: Please allow the bearer to purchase goods to the value of \$60, and charge the same to my account.

HORACE WARNER.

An order is not mandatory. The holder is not obliged to present it, or to trade the full amount, nor is the merchant obliged to fill the requisition. In sending a stranger for any kind of movable property the sender should make out a written order and not rely on a verbal request. One should be very careful in honoring a verbal order, for it may be the person presenting it is a swindler.

When the order is for the delivery of a specified article or articles, a receipt should be given by the person bringing the order, thus:

CHICAGO, May 10, 1902.

James P. Smith: Please deliver to bearer, Henry Walker, my roadcart, left for repair.

GEORGE W. JONES.

CHICAGO, May 11, 1902.

Received of James P. Smith on the order of George W. Jones, one roadcart.

HENRY WALKER.

ASSIGNMENTS.

Assignments are any simple form of statement properly witnessed, which transfers the right of property to a designated person.

SPECIAL POINTS ABOUT NOTES.

To be on the safe side, it is well to see to it that any note offered for negotiation is dated correctly; specifies the amount of money to be paid; names the person to whom it is to be paid; includes the words "or order" after the name of the payee, if it is desired to make the note negotiable; appoints a place where the payment is to be made; states that the note is made "for value received;" and is signed by the maker or his duly authorized representative. In some states phrases are required in the body of the note, such as, "without defalcation or discount;" but, as a general thing, that fact is understood without the statement.

The following rules have been compiled from the best authorities and cover the whole ground of the law of notes with accuracy and clearness:

There are two parties to a note, the maker and the payee.

If a note is lost or stolen, it does not release the maker; he must pay it, if the con-

sideration for which it was given and the amount can be proven.

Notes bear interest only when so stated.

A note made on Sunday is void.

A note obtained by fraud, or from a person in a state of intoxication, cannot be collected.

"Value received" is usually written in a note, and should be, but is not necessary. If not written, it is presumed by law or may be supplied by proof.

The maker of an "accommodation" bill or note (one for which he has received no consideration, having lent his name or credit for the accommodation of the holder) is not bound to the person accommodated, but is bound to all other parties, precisely as if there was a good consideration.

No consideration is sufficient in law if it be illegal in its nature.

A note indorsed in blank (the name of the indorser only written) is transferable by delivery, the same as if made payable to bearer.

If time of payment of a note is not named, it is payable on demand.

The time of payment of a note must not depend upon a contingency. The promise must be absolute.

The holder of a note may give notice of protest either to all the previous indorsers or only to one of them; in case of the latter he must select the last indorser, and the last must give notice to the last before him, and so on. Each indorser must send notice the same day or the day following.

Neither Sunday nor any legal holiday is counted in reckoning time in which notice is to be given.

The loss of a note is not sufficient excuse for not giving notice of protest.

If two or more persons, as partners, are

jointly liable on a note or bill, due notice to one of them is sufficient.

If a note is transferred as security, or even as payment of a pre-existing debt, the debt revives if the note or bill be dishonored.

An indorsement may be written on the face or back.

An indorser may prevent his own liability to be sued by writing, "without recourse," or similar words.

Written instruments are to be construed and interpreted by the law according to the simple, customary and natural meaning of the words used.

The finder of negotiable paper, as of all other property, must make reasonable efforts to find the owner, before he is entitled to appropriate it for his own purposes. If the finder conceal it he is liable to the charge of larceny or theft.

One may make a note payable to his own order and indorse it in blank. He must write his name across the back or face, the same as any other indorser.

An executor or administrator may indorse and transfer the note of a deceased person.

FORMS OF NOTES.

A Note Negotiable Only by Indorsement.

\$200 CHICAGO, Nov. 26, 1901.

Three months after date I promise to pay to John H. Munger, or order, two hundred dollars, value received.

J. T. NORTHROP.

A Note Not Negotiable.

\$200. ST. LOUIS, Nov. 17, 1901.

Ninety days after date I promise to pay Charles C. Sears two hundred dollars, value received.

SAMUEL ATKINSON.

Note Bearing Interest.

\$100.

BATON ROUGE, LA., May 26, 1902.

Six months after date I promise to pay R. V. Jennings, or order, one hundred dollars, with interest, for value received.

JOHN Q. WATSON.

A Note Payable on Demand.

\$150.

PHILADELPHIA, Nov. 30, 1901.

On demand I promise to pay Edgar Whittlesey, or bearer, one hundred and fifty dollars, value received.

JOHN R. CHAFFING.

A Note Payable at Bank.

\$100.

CINCINNATI, Dec. 24, 1901.

Thirty days after date I promise to pay Mark I. Rankin, or order, at the Second National Bank, one hundred dollars, value received.

FRANK T. MORRIS.

Guaranty of a Note.

For value received, I guarantee the due payment of a promissory note, dated October 8, 1901, whereby John Paxson promises to pay George Ruthledge eighty dollars in three months.

St. Louis, October 10, 1901.

THOMAS TODD.



SINGLE TAX: ITS MEANING AND ITS THEORIES

Henry George, a profound student of financial and fiscal systems, was the first popular advocate of the theory now known as the "single tax." Simply stated, it means only to charge any one occupying land, the exact rental value of the bare land, without improvements, taking the

rent thus collected, in place of all other taxes of any sort, as public funds for public uses. It does not suggest displacing any one from land occupied and used. The supporters of this theory are very active, and rapidly increasing in number. They issue the following statement of their position:

The single tax would:

1st. Take the weight of taxation off the agricultural districts where land has little or no value irrespective of improvements and put it on towns and cities where bare land rises to a value of millions of dollars per acre.

2d. Dispense with a multiplicity of taxes and a horde of tax-gatherers, simplify government and greatly reduce its cost.

3d. Do away with the fraud, corruption and gross inequality inseparable from our present methods of taxation, which allow the rich to escape while they grind the poor.

4th. Give us with all the world as perfect freedom of trade as now exists between the States of our Union, thus enabling our people to share through free exchanges in all the advantages which nature has given to other countries, or which the peculiar skill of other people has enabled them to attain. It would destroy the trusts, monopolies and corruptions which are the outgrowth of the tariff.

5th. It would, on the other hand, by taking for public use that value which attaches to land by reason of the growth and improvement of the community, make the holding of land unprofitable to the mere owner and profitable only to the user. It would thus make it impossible for speculators and monopolists to hold natural oppor-

tunities unused or only half used, and would throw open to labor the illimitable field of employment which the earth offers to man. It would thus solve the labor problem, do away with involuntary poverty, raise wages in all occupations to the full earnings of labor, make overproduction impossible until all human wants are satisfied, render labor saving inventions a blessing to all, and cause such an enormous production and such an equitable distribution of wealth as would give to all comfort, leisure and participation in the advantages of an advancing civilization.

With respect to monopolies other than monopolies of land, we hold that when free competition becomes impossible, as in telegraphs, railroads, water and gas supplies, etc., such business becomes a proper social function which should be controlled and managed by and for the whole people concerned through their proper government, local, state or national, as may be.



HOW FIRES ARE EXTINGUISHED

While cities have been growing so rapidly, and sky-scraper buildings have become such a common feature of the cities, it has been necessary to study constantly for the improving of methods for fighting fire which might destroy property of such great value. So it is that city fire departments have been organized to a high degree of perfection, both for the extinguishing of the flames, and for the saving of life of those who may be in danger. Some of the most ingenious and active of American inventors have busied themselves in this direction, and we do not need to be told that the

fire departments include men of tried bravery, whose deeds of courage almost daily rival or excel the most daring deeds of soldiers in battle.

The organization of the fire department in such a city as Chicago, for instance, is a matter of the greatest importance to the entire community. It must be efficient, kept up to the highest standard of excellence, and supplied with the bravest of men and the best of material at all times, if it is to do this work properly. However much political influence may have affected the appointment and administration of the police force, the community has rarely tolerated any invasion of the fire department with political influence. The annual expenditure for the fire department is nearly \$1,600,000 for the one city of Chicago. The department includes a total of nearly 1,200 men, organized in almost military fashion, with a marshal and his assistants, chiefs of battalions, captains and lieutenants, in addition to hundreds of engineers, pipemen, truckmen, drivers, stokers and watchmen. These brave men save every year many times as much as the department costs, and the citizens consider it a splendid investment to maintain it. At the slightest sign of deterioration in the fire department, or any reduction in the number of men employed in it which might reduce its efficiency, the fire insurance companies promptly raise their rates for insurance, so that the increase in premiums paid in the city far more than exhausts the slight saving made in the expense of the department.

These facts are typical of the conditions in every other city throughout the country. Even in small towns where no paid fire department is maintained, the custom is to be liberal in the support of volunteer compa-



FIREMEN'S EXTENSION LADDER IN SERVICE.

nies, which are usually equipped with the best appliances that the community can afford. In spite of this, the fire losses for the year 1901, the last for which figures are obtainable, amounted to more than \$150,000,000, while the loss in life exceeded 200. With such a showing of costly disaster, it is not strange that every effort possible is made to improve the methods of averting such calamities.

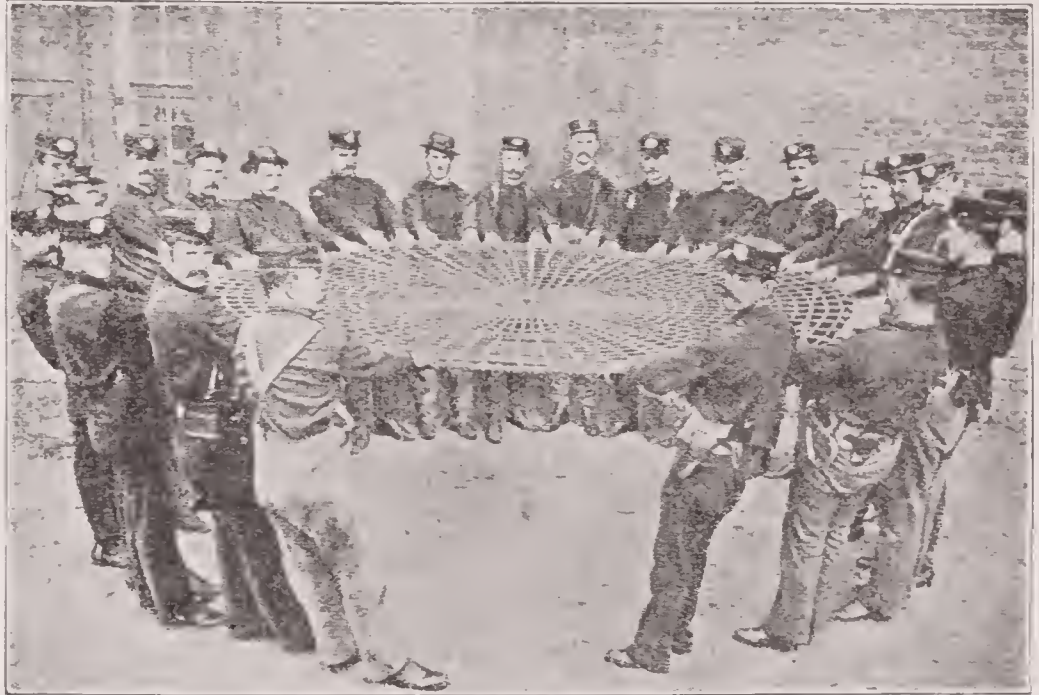
Some of the appliances recently put into service in fire fighting are ingenious in the extreme, although they are not always complicated, the simplest being sometimes the best. Portable fire extinguishers are made, by which, if a fire be reached early in its progress, the flames may be extinguished without the aid of water or engines. This apparatus is chemical in its character, releasing gases or liquids which are unfavorable to fire, smothering it as soon as they come in contact with it. One of the simplest of these consists of a small bottle of acid sealed with mica and containing a rubber-covered lead ball. This bottle is within a larger one, holding in addition some gallons of water in which soda is held in solution. The whole apparatus is enclosed in a metal case, and fitted with a hose. When the alarm is given it is inverted, the ball breaks through the mica, and the released acid coming into contact with the soda and water generates

gas, which discharges a stream of the liquid about fifty feet.

All firemen agree that the first five minutes of a fire are worth more in fighting it than the next half hour, so that all efforts are made to be as prompt as possible in reaching the scene of danger. Horses ready harnessed and trained to start instantly when the alarm is given, men on the alert every moment when they are on duty, and buildings properly constructed and equipped with safety in view, are prime essentials in addition to the apparatus itself. Nowadays mills, factories and large buildings of all sorts are equipped with hose, ladders, hydrants, fire extinguishers and fire escapes. The employes are organized into companies and drilled to fight fire so as to be ready for any emergency.

There is a firemen's training school in New York, which prepares men for active service in the department before they are permitted to begin the actual responsibilities of the work, and in Chicago and other cities the same results are obtained by drill of all new recruits in the department. They are taught to handle lifelines, safety nets into which people may jump from burning buildings, and the hose, hooks and ladders themselves. They are given drill with the remarkable extension ladders and extension nozzles which enable fires in tall buildings to be fought and rescues to be made, where such work would have been impossible a

few years ago. Then they are finally put to work as a part of the crew of an engine or a hose cart, and begin to take their lives in their hands at every call to duty. The public has an immense admiration for the firemen and they can always count on ap-



NET FOR CATCHING THOSE WHO JUMP FROM BURNING BUILDINGS.

plause for their bravery and support when they need assistance in any worthy movement. There is a halo of glory about a fireman's head which is universally recognized, and until all buildings are proof against destruction by flame, which may be true, thanks to improved building methods, after many years, he will always stand in the place of distinction.



ASBESTOS CLOTH THAT WILL NOT BURN

A long, lank, slow-voiced Englishman left his native land a score of years ago and settled in Quebec, where he hired out as a laborer in a lumber yard. His great bodily strength, supplemented by his energy and

activity, soon won him an excellent position. After he had been at work a number of months he returned one cold winter evening to the capacious, shed-like building in which they all lived. Seating himself comfortably before the pot-bellied cast-iron stove, the open mouth of which glowed red with heat, he deliberately drew off his long, wet boots. Then a pair of socks, much the worse for Quebec mud, came off one after the other, and his companions saw him coolly fling them into the fire.

They made no comment on his action, but when, almost immediately afterward, they saw him reach into the stove with a poker, pull out the apparently blazing socks, and, after giving them a shake, proceed with the greatest unconcern to draw them on his feet again, they stood aghast. It was plainly an exhibition of witchcraft. Then they scrambled over one another in their haste to reach the door, through which they burst into the dark.

The next day they called on the manager in a body and demanded the instant dismissal of the Englishman, loudly declaring that they would not longer eat or drink or work with such a monster. Inquiry being made at once, it was found that the big Englishman had worked in an asbestos factory before crossing the water, and being of an ingenious turn of mind he had managed to secure some of the material, out of which to knit himself a pair of socks. When they became soiled he cleaned them in the fire. But such explanations were of no avail with his ignorant companions, and he was compelled to leave his work.

Asbestos is a wonderful substance. Its name comes from a Greek word meaning inconsumable. Fire will not burn it, acids

will not gnaw it, weather will not corrode it. It is the paradox of minerals—for a mineral it is, quarried just like marble. The fibers of which it is composed are as soft as silk, and fine and feathery enough to float on water. Yet in the mines they are so compressed that they are hard and crystalline like stone.

Although the substance has been known for ages in the form of mountain cork and mountain leather, comparatively little has been learned as to its geological history and formation. A legend tells how Emperor Charlemagne, being possessed of a tablecloth woven of asbestos, was accustomed to astonish his guests by gathering it up after the meal, casting it into the fire and withdrawing it later cleansed but unconsumed.

Yet, although the marvelous attributes of asbestos have been known for so long, they were turned to little practical use until about twenty years ago. Since that time the manufacture of the material has grown until it can take its place shoulder to shoulder with any of the giant industries of this country. Indeed, so rapid has been its progress and development that there is almost no literature of any kind on the subject, and to the popular mind it is still one of those dim, inexplicable things. A dealer in asbestos goods says that the majority of persons who use the substance are firmly convinced that it is all manufactured by some secret process from wool or cotton.

Up to the late '70s nearly all the asbestos used came from the Italian Alps and from Syria, but one day a party of explorers discovered a rich deposit in what is known as the eastern townships of Quebec in Canada. Companies were at once formed, and in 1879 the mines were

opened. Remarkable as it may seem, however, although the Canadians started factories, in the operation of which they were substantially backed by English capital, it was an American concern, with headquarters in New York, that developed the manufacturing industry most rapidly. The company has now grown so large that it has branches in nearly all the large cities of the country, and the machinery used is specially made and peculiarly adapted to the manufacture of asbestos articles. There are also a number of large factories in England.

The Canadian mines are located in a wild, rough country, almost outside of the pale of civilization. The hills have worn themselves bare of earth, and the bleak rocks glare out in great, bald patches. At one time a scraggy growth of pines clung to the remaining ridges of soil, but forest fires, the hand of man, and the ravages of wind and weather, have left only the dreary waste of burned and blackened stumps. The sides of the hills gape with great holes in which the men—mostly French-Canadians—are at work. The veins of chrysotile, as the Canadian asbestos is called, are from two to four inches in thickness and are separated by thin layers of hornblende crystals. The nearer to the surface the veins run the coarser are the fibers and the less valuable.

The mining is done by means of the most improved quarrying machinery. Holes are drilled in long rows into the sides of the cliffs by means of steam drills. They are then loaded with dynamite and exploded simultaneously by wires connecting with an electric battery in such a way that a whole ledge of the rock falls to the bottom of the pit at once. Then the workmen break

out as much of the pure asbestos as possible and load it into great tubs or trucks, which are hoisted out by means of derricks and run along to the "cob house." Here scores of boys are kept busily employed crumbling or "cobbing" the pieces of rock away from the asbestos, and throwing the lumps of good fiber to one side, where it is placed in rough bales or sacks ready for shipment to the factory.

The greatest work in connection with the mining of asbestos is in disposing of the waste rock and the refuse of the quarry. Only about one twenty-fifth of the material quarried is real asbestos, and the rocky parts have to be lifted out and carried away to the dumps at great expense. As if in keeping with the forlorn and blasted appearance of the country the miners are a hard, uncanny class of men, migratory in disposition and exceedingly superstitious. Their wages range from \$1 to \$1.50 a day.

As the asbestos comes from the mines it is in small lumps of a greenish or yellowish hue and the edges are furred with loose fibers. The more nearly white the asbestos is the better its grade. The length of fiber is also of great importance, the longest being the most valuable.

From the mines the asbestos is taken by rail to the manufacturers in the United States. Here the lumps of the substance are emptied from the sacks and fed into the hopper of a powerfully built machine, not unlike an old-fashioned stone-process flour mill. They are crushed through a series of rolls, until the fibers are all separated into fluffy masses, when they pass out along a trough and into a separator. Here the small pieces of stone and other refuse rattle out through a sieve, and the longer fibers are separated by a series of comb-like

sieves into various lengths. The very short ones are taken out to the pulp-mill, where they are ground up fine for the manufacture of solid packing for steam pistons, millboard and other commodities. The longer fibers are gathered together, carded, and spun into yarn, just like cotton or wool. After that the substance may be woven into cloth in various ways. The cloth is of a dirty white color and has a soapy feeling.

The uses of asbestos are almost innumerable. Ground fine, and combined with colors and oils by a secret process, it makes a beautiful paint, which is said to go far toward fire-proofing the surface to which it is applied. Various kinds of roofing are also made by treating strong canvas with a combination of asbestos and felt and backing it with manilla paper. It is extensively used for roofs of factories, railroad shops, bridges, steamboat decks and other places where there is danger of fire.

Nearly every one has seen the thick, asbestos-felt coverings for steam-pipes and furnaces. Asbestos-cement is sometimes used for hot-blast pipes and fire-heated surfaces. As a packing for locomotive pistons, valve stems and oil pumps it is almost indispensable. It is also made into ropes and mill-boards which can be used almost everywhere. Asbestos cloth is being used more every year. Some states require theaters to use an asbestos drop-curtain to protect the audience if the scenery catches fire. Some very beautiful drop-curtains have been made, and the ordinary spectator cannot distinguish them from real cloth.

The yarn is knit into mittens for workers in iron and glass. Goldsmiths use a block of asbestos to solder upon. Combined with rubber—vulcanized—asbestos has al-

most innumerable uses as an electrical insulator. In this form the substance resembles ebony, and is about as hard. The cloth is also of the greatest importance for acid-fitters in all kinds of chemical processes, for the reason that no acid will eat it.

Asbestos is found in a good many hundreds of places in the world beside Italy and Canada, but the fibers are nearly all splintery and brittle. Rich deposits have recently been found in Wyoming, California and Montana, and the United States may soon come to the front as a producer of the substance. With asbestos worth about \$50 a ton, as it is, a good mine of asbestos is more valuable than a gold mine, and as the substance becomes better known and more used it will be still more precious. The time may not be far distant when firemen will be clothed in suits made from asbestos.



MINERAL WOOL AND ITS USES

Since the discovery, some years ago, that asbestos could be felted together into a sort of paper and used wherever a nonconducting, noncombustible packing was needed, the demand for it has steadily increased. New forms and new uses are continually appearing, while the supply is constantly diminishing. This has led to the search for a substitute.

By melting together the various minerals of which asbestos is composed, a material of the same composition is easily obtained, but the stringy, fibrous quality which makes the asbestos so valuable is wanting. An accidental blast or stream of melted slag from an iron furnace gave the first and most important step in the solution of the

problem, and from this it has been worked out almost to perfection. At first "glass," or "mineral" wool was made largely from slag, which contains many of the minerals needed—sand, lime and iron. But this product was too glassy, was not tough enough, and melted too easily.

A careful analysis of asbestos was made, and the minerals—limestone, sand, fire-clay or kaolin and iron slag—containing the proper elements, were mixed.

As made now, by the improved methods, waste products from other factories are used principally. Broken glass from windows and from bottle houses furnishes the sand and a part of the lime; pieces of fire-clay bricks, broken glass-pots and dish-ware that has warped and cracked in the kilns furnish the clay; and iron slag from the puddling ovens supplies the iron and part of the sand and lime. A little extra limestone is added. These waste products, besides being cheaper, are better than simple sand, lime and clay would be, as they are in a hard, chunky form, and "stand up" in the furnace, allowing a better circulation of air and gas while heating. Loose sand and clay would pack.

The materials are crushed and mixed according to a rough formula, which is worked out by experiment. It is very necessary that the amount of each should be just right. If too much glass is used the wool is brittle and harsh; if too much clay, the fibers are coarse and heavy, and if too much iron, the product is dark and does not sell well.

The mixed material is placed in tall fire-brick furnaces, with alternate layers of coke, each layer being about one foot deep. Natural gas, where obtainable, is led into the bottom of the furnace, the fire is lighted

and a blast of air from a blower is turned on, getting up an intense heat. The glass melts, acting as a flux, and melting the other materials. The part nearest the bottom of the furnace melts first and the whole mass settles down. When the bottom is sufficiently liquid a small hole is opened at the side of the furnace, and the liquid mass is allowed to flow out in a stream about one inch in diameter. As this falls a jet of steam from two flat, fan-shaped nozzles is directed against it, blowing it into a fine spray which, on cooling, is a white, fibrous mass resembling fine, well-washed wool, hence its name.

The spray is blown through a small window into a large collecting room. While the blast is on this room is filled with a white cloud, looking like cotton down. Two furnaces and two rooms are used, alternating with each other. When the blast is finished in one furnace, the downy wool is allowed to settle, and is then scraped from the sides, the floor and the ceiling; it is weighed, packed in bales and then is ready for the market.

The heaviest part which settles nearest the window contains little, beadlike bodies, called in the trade "shot," and due to imperfect blowing. This is remelted or sold for rough packing. The uses of the mineral wool are very numerous and are multiplying all the time. The chief ones are the adulteration of asbestos; packings to retain heat, as on steam pipes, steam cylinders and boilers; and packings to keep out heat, as in ice machines, refrigerators, cold-rooms and cold-storage warehouses. Of late large amounts are used for the deadening of walls and floors in fireproof buildings. The mineral wool is used either loose or in the form of paper, felting or thick wadding.

HOW ARTIFICIAL SILK IS MADE

Dr. Frederick Lehner of Zurich, Switzerland, has opened an active competition with the silk worm by the invention of a cheap and simple process of making an excellent quality of artificial silk. It has been known for a good many years in the scientific world that a substance of practically the same chemical composition as silk could be made, but the secret of rendering the process industrially practical remained undiscovered until Dr. Lehner took up the work. The basis of the discovery rests on the well-known truth in chemistry that many vegetable fabrics, such as waste cotton, cloth, flax, jute and wood, when digested by treatment with acids and alkalis are transformed into cellulose, a substance forming the walls of cells. By combining this material with nitric acid, certain nitrates of cellulose are formed, the higher compounds of which are such well-known explosives as cordite and tonite. The lower or pyroxylin nitrates are less explosive, being a gelatinous substance. If this be drawn out it will divide into numerous short threads or strings of a fine, shiny texture, somewhat like gun-cotton, and most inflammable when dried. To this point a great number of chemists succeeded in getting, but they could not give the product of their test-tubes a sufficient viscosity to admit of being drawn out into long threads. Dr. Lehner tried various solutions, but even when the amount of the pyroxylin was reduced to 7 per cent the compound was still too gelatinous to be worked.

At last he discovered that by adding dilute sulphuric acid to the alcohol ether solution, a part of the water was taken up and "split off" and the nitrates broken

down, leaving a 12 per cent solution which was perfectly fluid and of the required viscosity. The process having once been discovered, the manufacture of the fluid is an inexpensive and perfectly simple operation for any chemist.

The method by which the common-looking yellow liquid is converted into beautiful silk threads is most interesting. The machine used is nothing more than a modification of the ordinary spinning frame. The great glass jar containing the silk fluid is set up on a high bench or shelf and the fluid is conveyed downward through pipes to a number of bent glass tubes resting in a trough of cold water. The orifices in the ends of the tubes are exceedingly minute, and rest just beneath the surface of the water. As the fluid flows through the tubes it is quickly cooled and begins to coagulate. On leaving the water about 60 per cent of its soluble portion has been washed away and the remaining thread is of a fine, rich lustre. Six or seven of the strands are gathered up and twisted together, exactly as silk or woolen threads are spun. After it has been wound upon the frame the artificial silk dries and hardens, losing in this process the remains of its soluble matter. In a week's time the thread cannot be distinguished from the real article even by a silk expert except by microscope or chemical examination.

But the thread in this condition retains its characteristics as a nitrate, and is almost as inflammable as gun-cotton. Of course it would never do for use while there was danger at any moment of its blowing up. The consequences of wearing a dress made of such material may be easily imagined. Consequently the thread is sub-

mitted to a last process—that of denitration, in which by the use of ammonium sulphide the nitric acid is all neutralized.

After the thread has been again dried, it is really less inflammable than natural silk. It can now be spun to any required thickness, and it is said that the resulting yarn is much smoother and more even than the genuine article. It has another advantage. When the machines are once started the threads can be spun to any required length—endless, if necessary—thus obviating any necessity of stopping the cloth-ooms to splice a thread. In addition to this the process can be carried on through winter and summer in any part of the world. There will be no need of mulberry forests or worm hatcheries, for by taking a quantity of cast-off clothing, and perhaps some wood pulp, and mixing them with the acids, the work is done.

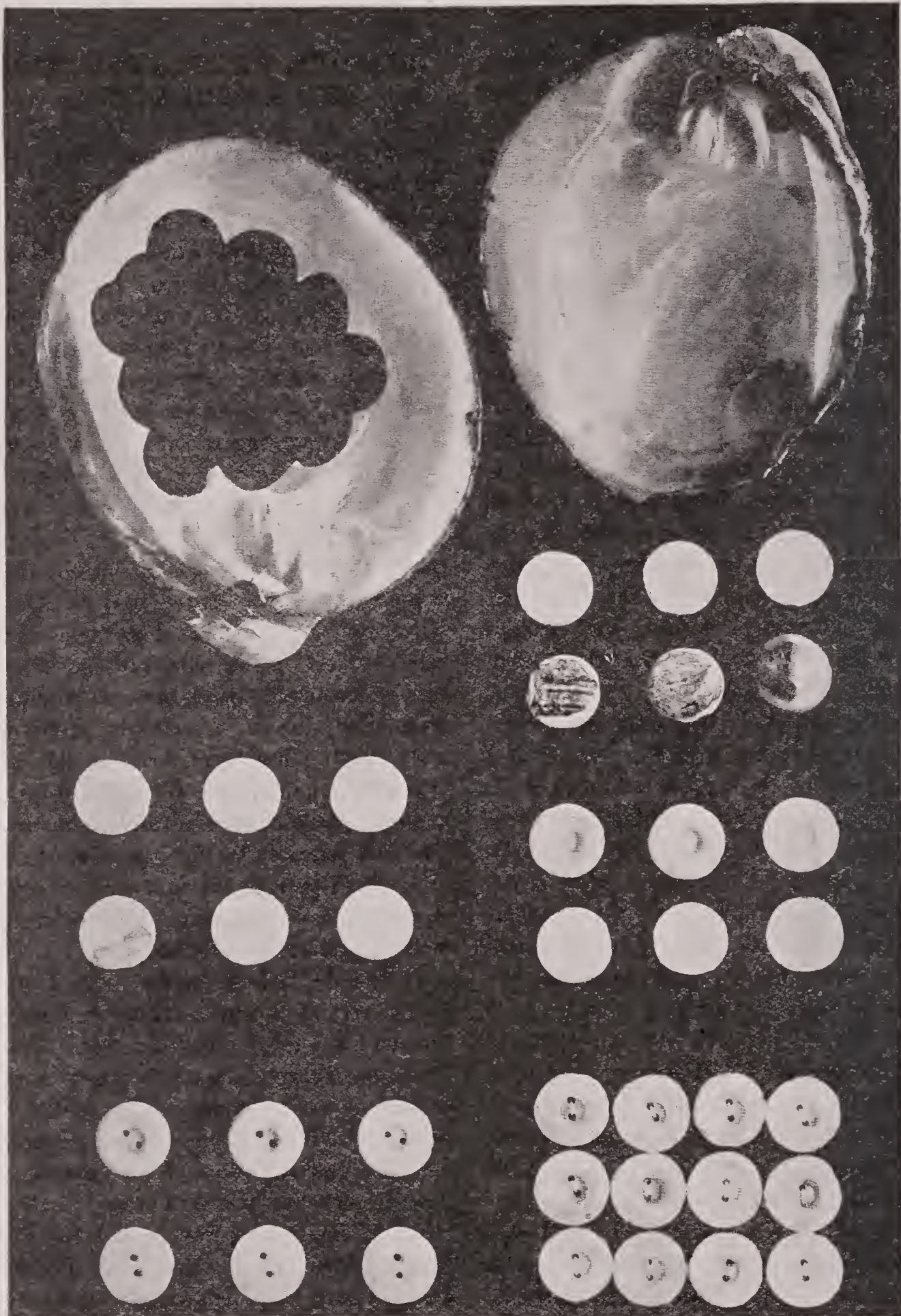
Yet the artificial silk lacks in several particulars of being as good as the natural product, and it is proposed to make it an economic factor in the manufacture of real silk goods. The warp of a fabric may be made of genuine silk and the woof of the artificial silk. In this way the artificial silk would take the place of wool or cotton in a mixed fabric, which would be just as cheap and much finer.

The relative strength of the artificial silk, compared with Italian pure silk, is as 68 to 100. Pure silk has but little elasticity, and when stretched does not go back to its original length; neither does the artificial silk, but its stretching quality (before breaking) is as 73 to 100 relatively. Measure for measure, the relative weight of the same average diameters of pure and artificial silk is 7.25 per cent more in the latter.

BUTTONS, THEIR INVENTION AND MANUFACTURE

Adam did not wear buttons. Even when his wardrobe reached the dignity of containing "other clothes," he was compelled to fasten his apparel with a sash or borrow a spike from Tubal Cain. In fact, until the beginning of the fourteenth century, the world managed to struggle along without these modern conveniences. Buttons were first used as ornaments. They were sewed on according to the taste or caprice of the maker or wearer of clothing, and they were seldom placed where they might have been of practical service, even had there been buttonholes to match them. Some time in the latter part of Queen Elizabeth's reign it was discovered that a small slit cut in the cloth and shoved over the button made these ornaments useful. From that time on the making of buttons grew until it has become one of the most important industries. With the practical use of buttons came a revolution in dress. The last relic of the flowing robes handed down from patriarchal days was consigned to the shelves of museums, and the simpler modern dress was introduced.

It was the fashion in the early days of buttonmaking to sew as many buttons on the clothing as the texture would bear. Even the laboring classes managed to deck themselves to a degree which to-day appears ridiculous. This at once created a demand, and the close of the seventeenth century saw the button industry well established in Europe, the center being then, as now, Birmingham, England. The first buttons were very expensive. They were made chiefly of gold and pearl, rich in design, and inlaid with precious metals and



BUTTONS FROM MISSISSIPPI RIVER PEARL SHELLS.

Showing various stages in the process of manufacture, from the shells to the finished buttons on cards ready for sale.

jewels. Following these came the cloth-covered and silk-covered buttons, which were made entirely with the needle. These brought a high price, and the workmen received the largest wages in those days for needlework. As the demand for buttons increased and man's inventive genius was taxed, machines were produced for the making of steel, brass, inlaid, plated and lacquered buttons, and later for the rapid manufacture of covered buttons.

These last are made by covering with silk, lasting, brocade, twist, velvet, mohair and various cloths, metal disks which have been previously cut out of sheet iron and molded with dies. The frame of this button consists of two pieces of sheet iron, the under piece being slightly convex and having a small round hole in the center through which a tuft of canvas is pressed. This is for sewing the button to the cloth. The upper disk is also slightly convex and made a little larger than the lower piece. The edge of the upper disk is turned down about a sixteenth part of an inch in the medium-sized buttons. These disks are cut from the sheet, formed and made ready for covering by one motion of the "fly press" or punching machine.

For covering, another machine is used, simple in construction, but capable of turning out a great many buttons in a day when operated by an expert. It consists of a central upright shaft, to the lower end of which is attached a die so constructed as to press a piece of cloth around and under the upper disk of the button. The shaft is allowed to move up and down through two heads fastened to a stout frame of iron. Below the upper die is a contrivance having two dies which may be moved at will in line with the upper die. In these the

parts of the button are placed. One holds the upper disk and the piece of cloth, the other the under disk. A pressure of the operator's foot on the treadle brings the upper die on the first lower die. This shapes the cloth. The second lower die is shoved under, the treadle is pressed and the button is complete. The dies have not only folded the cloth around and under the upper disk, but they have clinched the two disks of the button close together. An expert worker may make from seventy-five to eighty-five gross of buttons a day with this machine.

Buttons made of vegetable ivory are widely used in this country and in England. The material is obtained from a palm tree that grows in South America. It has the name of "tagua plant," and in Peru it is called "negro's head." When young the seed of this palm contains a milky substance which with age becomes very hard and white, resembling ivory. The seeds as used in commerce are from an inch to three inches in size and almost round. Before they go to the buttonmaking machines they are steamed to render their cutting easier. Then they are sawed into slices of proper thickness. The button is cut out with a tubular saw and each button is turned separately in a small lathe. Other machines are used for drilling holes, polishing and finishing the buttons. Vegetable ivory is capable of receiving almost any color, and the dyeing of buttons made from it is one of the most important and most carefully guarded secrets of the craft.

Livery, emblem and society buttons are made by stamping, the machines used being the disks for metal buttons. The dyeing the same in principle as those for cut-

sired figure which the face of the finished button is to assume is cut in the upper die, the reverse being made in relief on the under die. They are stamped and pressed together without soldering.

Materials employed in button making are as varied as the styles of buttons. In addition to metal-covered buttons and those made from other metals, glass, porcelain, horn, bone, India rubber, mother-of-pearl and other products of shellfish and various woods are used. The shells for mother-of-pearl come from the Persian Gulf, the Red Sea, the Pacific coast and Panama. Paper buttons have been made, but not extensively. An English invention uses slate or slit-stone in making buttons and button bodies.

The first buttons made in the United States were of wood, covered by hand with different materials, principally silk. The operation was laborious, but it resulted in the invention of machinery which has built up large factories in the east, Waterbury, Conn., and Easthampton, Mass., being centers of manufacture in this country. New York has several large factories.

The details of preparing the sheet iron for metal and metal-covered buttons are simple. The iron is first scaled by immersing it in acid, after which it is punched out with the dies. The neck, or "collet," is japanned, after being cut, and before the canvas tuft for sewing on is pressed into place. The hollow between the neck and shell is then filled with brown paper, called "button board." The making of these basic parts of the cloth-covered button is confined almost entirely to the eastern states. Western manufacturers buy the material ready to cover. Button shanks, or eyelets, are made of wire on a machine

which cuts the wire into desired lengths, bends it into loops and leaves it ready for insertion into the lower blank.

The name "shell" is given to metal buttons made of two disks pressed together and fastened without soldering. A cloth-faced button is made by gluing a piece of cloth, cut the exact size, into the top of a rubber or vegetable ivory body. This leaves a rim of hard material to protect the edges of the button from wearing. In these the thread holes are drilled through a knob turned or molded on the back of the body.

The great decrease in the price of buttons from that which made the first manufactured a luxury, has been due to the introduction of machinery, which now does almost the entire work. Skilled labor does not occupy a large place in the making of buttons, which may also account for their comparative cheapness. Girls and boys may operate nearly all the machinery, which is a combination of automatic features, leaving little to the operator but dexterity in handling the different pieces for the dies.

One of the curious freaks of buttondom, invented some years ago, was a "bachelor's" button. This consisted of an ordinary trousers button with a safety pin attachment. It was to answer in cases of emergency, but it has not succeeded in entirely banishing the more homely but reliable horse-shoe nail.



IN A TYPE FOUNDRY

Every type in a font, like every link in a chain, must be perfect in itself, or else the work of the maker counts for nothing. Perhaps in no other industry, unless it be watch-making, is such scientific accuracy

required in every detail. Each measurement must be made to the thousandth part of an inch, and if a mold or a die is not exact to a hair's breadth a whole casting may be lost. For in this age of newspapers every printed page is judged to a certain extent from an artistic point of view, and if the impressions of some type are heavier than those of others, or if the alignment is imperfect or the spacing uneven, it is subjected to condemnation. In this way type-founding becomes a real art.

One of the largest manufactories of type in the world is located in Chicago and the amount of type in tons which it turns out yearly runs well up into the thousands. It is a big, busy building humming with life and movement, more than 350 men and girls working at its benches every day.

Follow the superintendent down the basement stairs, around the huge boilers and engines, and into the little corner room where the type metal is melted. Here the raw materials are brought, weighed and corded up ready to go to the big iron crucible. There are "pigs" of lead, heavier than an ordinary man can lift, "pigs" of tin and "pigs" of copper. The antimony comes from Japan in square, solid blocks weighing thirty pounds each, and before melting it is crushed to powder between the iron jaws of a crushing machine. Formerly the workmen broke it up with hammers, but the antimony being poisonous, that method was abandoned.

The four metals are mixed according to a secret formula—the lead being the largest ingredient—and placed in a crucible. Antimony, which is a most expensive metal, is used because it gives hardness to the type-composition and because it has the unusual quality of expanding in cooling, thus

preventing the type when cast from "falling away" from the mold, and produces sharpness of the face and body of the type. After being melted and thoroughly mixed by stirring the metal is run into pans, and when cool it is ready for the casting machines.

The first step in type-making is the cutting of the letters desired on the ends of pieces of hard, fine steel. This is very difficult work, and the men who do it receive high wages. Each letter in a font must be exactly the same height and the width must be cut according to rule. A separate one of these dies or "punches" is required for each character in every font of type, and the making of them is the most expensive part of the business. Some of them cost as high as \$7.

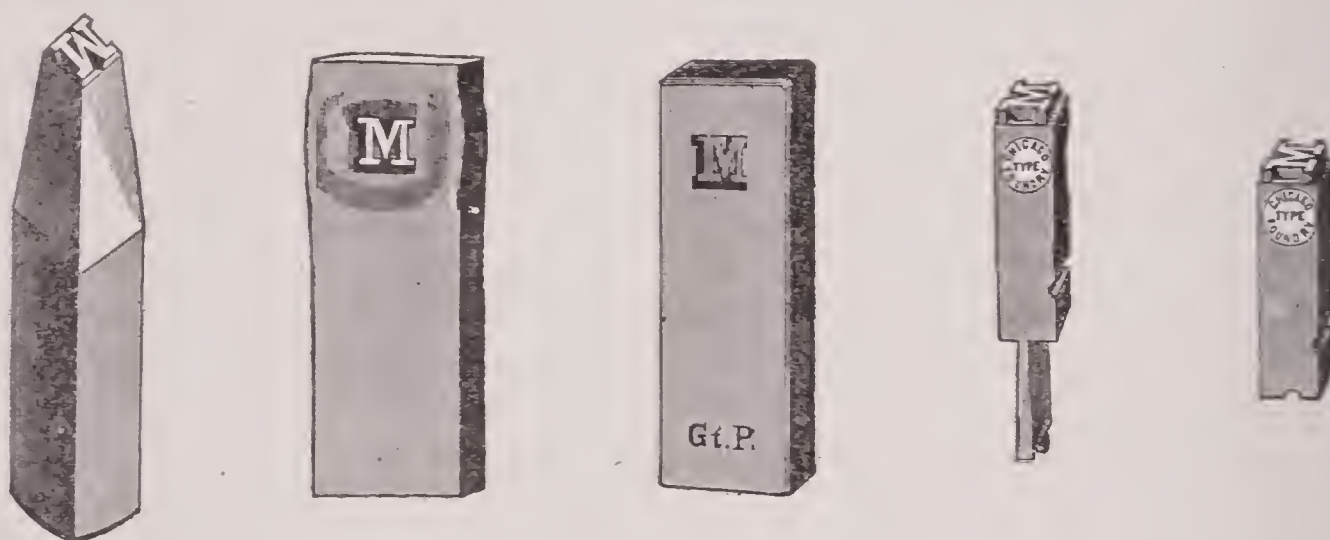
When a set of "punches" is complete it goes to the matrix department. Here little rectangular pieces of pure copper known as "strikes" have been prepared. For minion or long primer type they are about two inches long by half an inch broad. At exactly the proper point near the top of each the steel die is driven in and then the "strike" or embryo matrix goes to the fitter, who rubs and polishes it down on big pieces of sandstone until it is everywhere square and perfect and the depth of the letter is exactly the same as in the rest of the font matrices. An electrotype matrix is also made, usually for use in casting display type, without going to the expense of cutting steel punches. This is done by immersing in a copper solution a piece of brass the size of a "strike" and having a hole at the upper end and allowing copper to be deposited by the action of electricity on a metal die of the desired letter, which is suspended with its face just inside the hole in

the brass. Great pains is taken to keep all these molds and dies perfect. More than \$200,000 worth of them are stored in a big vault in the basement.

Next the mold is made. This work requires the most skilled mechanics in steel. The pieces are all cut-out by lathes, planers and shapers and ground down to just the right size and then polished on emery laps. There are two main parts to the mold, and they may be so adjusted as to make room for casting the bodies of letters of any width from a 3-m size to an i size. A great deal

water from above. When the movable arm is as far back as possible, a half of the mold lifts and the type jumps out. At the lower end of each one there is a little "jet" of metal which clings and has to be broken off by an automatic device. In some of the larger styles of type the "jet" is removed by hand. When all of the a's in the font are made, the b matrix is put in, and so on to the end of the alphabet. A casting machine will turn out from 100 to 175 type a minute.

In casting small fonts where frequent



TYPE IN THE VARIOUS STAGES OF MANUFACTURE.

Showing in succession, from left to right, the "punch," the "drive" or "strike," the "matrix," the unfinished type with "jet" and the finished type.

depends on the absolute accuracy of these molds. The matrix is now fastened in the mold so that it will form one end of the hole between the two parts. Then one of the parts is fastened to the casting machine and the other to a movable arm. The metal is kept fluid in a little furnace heated by natural gas, and is projected with great force into the mold by means of a pump. At every revolution of the crank the mold approaches the pump spout, takes a charge of metal, and flies back with a fully formed type, which is cooled with air-blasts and

changes are made in the molds, the machines are driven by hand-power; but where fonts are large, such as those made for newspapers, steam is the propelling power and the indefatigable little machines go thumping along with little or no attention and do their work with a precision that almost equals human intelligence.

The type is not finished when it leaves the machine. A fringe or burr, somewhat like that which clings to a bullet cast in a mold, still adheres to its corners and sides. This is taken off by a number of girls who

rub rows of the type on sandstone laps. The deftness and ease with which they handle the type, which would so easily "pi" in the hands of an inexperienced person, are simply wonderful. All italic and script type are sent to be "kerned." This is a process of cutting away and smoothing the body around the projecting parts of the letter, and it adds materially to the cost of these two classes of type.

The "setters," nimble-fingered girls, sit around low tables, the tops of which are cushioned in velvet. Here the type is dumped and the girls set them in long lines with the nicks uppermost. They now go to the "dresser," who slips the row into a stick or dressing-rod about three feet long, turns them on their faces, fastens them into a slit in an iron bench specially constructed for that purpose, and with a plane cuts a groove in the bottom, which removes the burr left in breaking off the "jet," and gives the type two legs to stand on. He then deftly turns the long row upside down and dresses off the uneven places along the upper and under sides. One firm in Chicago has in use a wonderful new machine which performs most of these operations automatically. It casts the type, breaks off the jets, rubs down the two sides, dresses off the body and grooves the jet end of the type. The type are cast singly, and follow one another through channels, which contain the dressing and grooving devices, onto a long wooden stick.

The work of the inspector, who now receives the type, is the most trying and painstaking of any in the shop. He sits before a big window and with a magnifying glass tightly clamped into his eye examines each type in the row, and if he sees a single defect in any of them he picks the type out

with a needle-like awl and it is returned to the melting kettle. Long years of experience and keenness of vision enable the inspector to detect imperfections that would never suggest themselves even to his associates in other divisions of the industry unless their attention was especially directed to them. In the smaller sizes about one type in every twenty is thrown out, and sometimes even a greater proportion.

The lines are now broken up into shorter lines and put up in "galleys" or "pages," about four and one-half by six inches in size. The full font weighs 100 pounds, and if smaller fonts are ordered these are divided into smaller pages, each having its due proportion of "sorts" of letters and characters. After being wrapped in paper and marked they are ready for shipment.

A type font is sometimes measured by weight in pounds, and sometimes by the number of m's which it contains. Job fonts are always turned out by count. The proportion of letters in a font is interesting as showing how much more some letters are used than others. In a 3,000 lower-case m font of "minion 3," for instance, a type smaller than that from which this book is printed, weighing 280 pounds, there are 9,000 a's, 2,000 b's, 4,000 c's, 5,000 d's, 14,000 e's, 800 k's, and 500 j's. E is used more than any other letter in the alphabet. It is followed by t, with 10,000; then by i and a, with 9,000 each; then by s, with 8,000. The least used letters are z, with 300, and j and x, with 500 each. Of the numerals 0 and 1 are most used, having 700 each. Some of the fractions have fifty types to the font and the braces have only twenty-five each.

The great newspaper offices use thousands of pounds of type every year. But the in-

troductioin of linotype machines, which cast the type line by line as fast as it is set, has severely injured the business of making body type. A great Chicago dealer says that the linotype machines have cut in more than 25 per cent, the effect being felt most in the orders from the big city dailies. An effort has been made, however to fight the linotype machine with a machine which will set real type, and in this the type founders place much hope for the future. But the business of producing new styles of job type and casting them is still a great industry.



BINDING TWINE MADE FROM MANILA HEMP

One Chicago manufacturer produces enough binding twine every working day in the year to reach half way around the earth. The capacity of his manufactories, of which there are two, is eighteen miles every minute, or about 3,333,330 miles a year. The weight of the annual product is 16,000 tons, and it would stretch from the earth to the moon thirteen times, with a loose end left over that would girdle the earth nine times. If a train were to travel as fast as twine is made in the factory it would speed from Chicago to New York in about forty-five minutes. These factories make about one-third of all the binder twine consumed in the United States. The total amount would therefore be about 10,000,000 miles, or 48,000 tons. Allowing about two feet of twine for every bundle of wheat, the total number of bundles harvested would be 105,600,000,000, a simply inconceivable amount.

Chicago is by all odds the great twine-producing center of the world, and it dis-

tributes its output from China to Peru. The largest amounts are used in Minnesota and Dakota, but other states are also great buyers. Of foreign countries Argentine is far in the lead as a twine consumer, but large sales are made in South Africa and Australia; in fact, everywhere in the world that wheat will grow.

The best twine is made from East Indian manila hemp. It is the product of a plant known to botanists as *musa textiles*, a variety of banana palm which grows only in the Philippine islands. Some fairly good varieties of hemp, although far inferior to the manila, are now being grown in southern Mexico. Yucatan supplies the much-used sisal, which comes from a plant known as the American aloe, resembling the century plant in appearance. The fiber takes its name from Sisal, a seaport town in Yucatan. The work of cutting the fiber, stringing it out, suspending it on racks to dry, and packing it for shipment employs thousands of the natives during a part of the year. All the rest of the time they employ in magnificent leisure, spending their earnings and waiting for the next sisal season. This Yucatan hemp is now much used, although it is not as strong and durable as the East Indian products.

The various kinds of hemp come to the factory storehouse in bales containing from 270 to 375 pounds. Some of them are bound in rattan and palm leaves, and covered with cabalistic lettering in some foreign language. Recently a little of the hemp grown in Kentucky as an experiment has been tried, but it was not found to be fit for binding twine, which must not only be strong and smooth, but uniform in size so that it will work well in the machine.

The warehouse is three stories high, 275

feet long by 100 feet wide, and is packed from top to bottom with hemp bales, the entire capacity being 5,000 tons. Great caution has to be observed in providing fire protection, for if the piles of bales once became ignited it would be almost impossible to extinguish them. The superintendent has to keep a sharp eye out when the bales are unpacked, for the wily Mexicans do all sorts of things to make them weigh heavy. Oftentimes great chunks of grindstones and cobblestones, to say nothing of wood and cheaper grades of hemp, are found packed inside of the bales. It pays better than hemp-raising, and doubtless the Mexican chuckles more over getting money in this way than he would if he had earned it.

The twine factory proper is a great building. In one corner of it is one of the largest engines in the world. It has the thirty-two-foot flywheel which attracted so much attention in Machinery Hall during the World's Fair, and the indicator registers up to 2,000 horse-power. One man who stands on the clean, varnished floor is the sole master of the great engine which keeps the thousands of spindles in the factory clicking away so busily.

When the bales of hemp come in from the warehouse they are torn apart and the workmen shake out each of the separate bunches, which are knotted at the end and somewhat resemble a horse tail, only they are nearly white and very coarse, the fibers varying from two to six feet in length. So closely is the hemp packed that a bale more than doubles in size when it is loosened.

The hemp now goes to the preparing-room, where the roar of the machinery is deafening and it is impossible to speak loud enough to be heard. The room is remarkably high, so that the thick hemp dust

which fills the atmosphere will be swept out and will not injure the employees. The hemp goes first to the scutching frame, which is a broad wheel about eight feet in diameter, the outer surface being covered with short, sharp pegs set close together. This is covered all over with a shield, which is pierced at one side with a square hole. Through this hole the hemp bunches are switched until the teeth have combed the fibers out straight, tearing away also a good deal of dust and short, valueless fibers.

The hemp now goes to the first spreader or breaker. This consists of two sets of belts, both covered with short metallic teeth or pegs, the first moving more slowly than the second. On being fed into the machine the hemp is spread out, carded and straightened, the second belting pulling it apart longitudinally and making the ribbon thinner. From the end of the first spreader a girl attendant, who is powdered with dust from head to foot, guides the big loose rope into high tin pails, from which it is fed into the second spreading machine, and so on through eight of them until the hemp ribbon is smooth and even and much thinner and narrower than at first.

It now goes in high tin pails to the bell machines, where it runs over numerous spools and rollers, which smooth it down beautifully, twist it and draw it out finer and thinner, making the fibers more and more compact. The picture on page 183 illustrates this part of the process. After going through two of these machines it is ready to be sent to the 600 spindles on the second and third floors.

It is difficult to give an idea of the scene in the spindle-rooms. Hundreds of machines, all just alike, with each part moving in unison, each belt flapping in line and

over all a deafening sound of whirring of wheels and clicking spindles. Among the machines a few girls move about quietly, keeping them free from dust and seeing that their insatiable mouths are always full. Here the ribbon of hemp runs from the pails through a very small hole, and then it is pulled very fast, so that it grows thinner, at the same time being twisted a little. Then it is fed on a big spool or bobbin in the form of the finished twine—650 feet to every bobbin. A very complete system of inspection and examination is in use in the factory for insuring absolute exactness in the size and strength of the twine. The binder attachment of a harvester is set up in the room, and a bundle of rag bags is bound from time to time to see if the twine is perfect.

The bobbins are sent up to the balling department. Here a great number of girls with incredibly nimble fingers are engaged in operating busy little machines which wind the twine from the bobbins into the well-known shape of the twine-balls. The balls are so made that the twine unwinds from the inside out, instead of from the outside in. The balls are now weighed, and twelve of them are placed in a fifty-pound package and covered with burlaps ready to be shipped to the farmer. Twine mills are operated only about ten months in the year, beginning in the fall and continuing until late in the summer. The selling season is, of course, before and during harvest time.



HOW VARNISH IS MADE

Varnish-making is a veritable aristocrat among trades. The varnish-maker goes about his work as serenely and leisurely as

though he wore fashionable attire instead of the spotless suit of overalls, which seems to be a superfluous article of clothing. The varnish factory is as quiet as the chapel of a deaf and dumb institution, except when the tap of an easy heel or the distant rumbling of a rolling barrel breaks the spell. The rush and whir of machinery, the hissing of high-pressure steam escaping from a poor joint, the rattle of loose belting and the quarrel of clashing metals are unknown in the calm precincts of a varnish factory. For the only machinery in the place is the little engine which drives the humming dynamo and the slow-moving pumps, which breathe so softly that they are noticed simply because they take up some space in the engine room.

The making of varnish requires but little manual labor, for the raw material is handled only in the case of the gums and shellac; the oil, turpentine and other liquids are pumped from the barrel to the finished varnish. It is in the handling of the raw material and finished product that the modern varnish factory is superior to the old-time ones, for the art of making varnish is the same to-day as it was eighty years ago.

Varnish was made in kettles years ago, and it is made in kettles to-day. It was made of gum, linseed oil and turpentine half a century ago, and gum copal, Calcutta linseed oil and North Carolina turpentine mixed together at varying degrees of heat make the finest and most expensive varnish which polishes and preserves the wood of sleeping cars and carriages to-day. There is not a varnish-maker who does not surround his business with trade-secrets, and the uninitiated is led to believe that varnish-making is an inherited art, handed

down from father to son, and something that cannot be taught by book learning or transmitted by word of mouth. But a varnish-maker who has received yards of blue-ribbon honors and dozens of diplomas and medals from various expositions, national and international, said not long ago that the true art of making varnish lay in the proper selection of raw materials and the intelligent handling of them in the process of manufacture by experienced men.

The base of varnish is gum copal, or the fossil gum found in Zanzibar, Sierra Leone, New Zealand, the Philippine islands and other places. The best gum is that of Zanzibar, and the poorest is the Manila from the Philippine islands. When the gum is received in the factory it is broken up into pieces about the size of small egg coal. The man who breaks it up, at the same time selects the gum, for in one chunk of the amber-like material there may be both transparent and almost opaque streaks; the white, transparent gum goes into the making of the best grades of varnish, the dark-colored gum into the poorer grades. After the gum copal is broken, it is run through a series of hand sifters which divide it into block, nut, chip and dust. This separation is made for convenience and economy in handling, and cuts no particular figure in the results. The gum copal is now ready for the kettle.

For first-class varnish only Calcutta linseed oil is used. This oil, as its name indicates, is made from the flaxseed of India, which, however, is crushed in England or Germany. The preference of American varnish-makers for linseed oil made in England or Germany to that made in this country, even though Calcutta flaxseed is used alike in all the linseed-oil mills, shows the

relative value placed on linseed oil cake or meal in America and Europe. In America the cake and meal, which are a residue of the oil-pressing, have less value commercially than the oil itself, so the American linseed oil man tries to get as much oil out of his flaxseed as he can, and sometimes he succeeds in obtaining 92 to 96 per cent of the oil from the seed. From the linseed oil man's point of view this percentage is first-class, but the varnish man does not like it, because the extra pressure required to secure so high a percentage of the oil lets loose what are called "foots"—little particles that will not melt with heat, will not be filtered out, and in spite of all the varnish-maker can do, persist in discoloring his varnish and forming sediment in the bottom of the storage tanks.

In England and Germany the Calcutta oil meal and oil cake are regarded as desirable food products, and commercially are of more value than the oil. In his desire to obtain as much cake as possible from a given amount of seed, the English and German oil man is satisfied with about 80 per cent of the oil in the seed. No "foots" appear in the English crushed Calcutta oil, and that is the reason American varnish-makers prefer it to home product.

Before the linseed oil is mixed with the gum it is boiled. The turpentine used for thinning the varnish is the best and purest grade of North and South Carolina turpentines. The boiled oil and the turpentine are kept in large storage tanks, and drawn out when needed.

The stack is the soul of the varnish factory. Here the gum is melted, the oil is mixed with it, and the dark and secret arts which enter into the making of varnish are practiced. The stack is a high brick

chimney, around the base of which are grouped a number of fireplaces, somewhat like open coke fires, which occupy hooded recesses. The fires are flush with the floor, and are supplied with air by means of air-ducts which pass from the outside of the building under the floor to the grates. The copper kettles in which the melting and mixing are done are on truck wheels, so that they can be rolled over a fire or taken off easily. Far above each fire is a large vent, leading into the stack, for the escape of inflammable fumes or gases loosed during the melting and mixing process, for those fumes must be kept away from the coke fires or there will be an explosion. By sending the gases of the coke fire up the chimney by means of flues at the base of the stack, and allowing the fumes arising from the kettles to escape through the vents far up the stack, all danger of explosions is avoided.

The copper kettles in which the gum copal is first melted are about three feet high and two and one-half feet in diameter. A loose cover fits over each kettle, and through a hole in the cover the varnish-maker stirs the melting gum with an iron tool. While the gum is melting, steam in large quantities escapes through the little funnel in the center of the lid. One of the secrets of the varnish-making trade comes into play while the copal is melting, for while one kind of the gum can be handled safely with 200 degrees of heat, another goes up to 600, and to mistake one for the other or keep the melted gum longer than it should be, means a bad mess. There seems to be an intuitive knowledge possessed by the varnish-maker on this temperature question, for, while all the gum looks alike to the unlearned spectator, the

varnish-maker allows one kettle to bubble merrily at 300 degrees, while its companion on the other side of the partition is spluttering at 500. After the gum has melted, a tool somewhat like a gigantic egg-beater is introduced and the melted gum is whipped, preparatory to letting in the boiled linseed oil. When the oil has been mixed with the liquid oil, the kettle is run back over the fire once more and the gum and oil boiled again. Then it is set away to cool, after which the kettle is taken to a room where a quantity of turpentine is mixed with the gum and oil, and the varnish is made.

But the varnish-maker, having ever before him a bugaboo of specks and foreign matter which might have been caught in the translucent, amber-colored liquid, first strains the varnish through cotton before it is pumped into the big storage tanks, where it is left to age for at least six months and perhaps two years, for varnish, like wine, improves with age.

That is all there is in making varnish. The varnish-maker must know just what heat is best for the different gums he uses; he must know just how long and at what temperature he must boil the combined varnish and oil, and he must know to a point how much turpentine to put into his varnish. Every stage of the process at the base of the huge stack is watched with a thermometer in the kettle, for no guess work or rule of thumb is permitted while the kettle is on the incandescent coke.

Shellac varnish is made in "churns," or barrels revolving on journals. The shellac as it comes from India looks like amber colored mica, for it is in thin sheets and almost transparent. This shellac is mixed with the proper amount of alcohol in the

revolving churn, the belt shifter is thrown over and the briskly turning barrel mixes the shellac and alcohol together.

The Zanzibar gum copal comes from the coast of Africa, between the Juba River and Cape Delagoa, contiguous to the island of Zanzibar. It is dug out of the ground by the natives, who bring it on their backs to the traders, and are said to be gloriously cheated by them. These African copals are the hardest, most transparent of all gum copals, and are used only for the most expensive varnishes. The Kauri gum copal comes from the northern island of New Zealand. It enters largely into the making of the middle and most used grades. The production of this gum is an important industry, amounting to about 7,000 tons annually valued at more than \$2,000,000.

Gum copal is found sometimes on the ground, but usually some feet under the surface. It is the fossil resin or gum of trees that are now extinct. An exception to this is the Kauri copal, which is the fossil gum of trees which are growing over the ground where the gum is dug up. Sometimes the natives mix in gum from living trees with the true gum copal, but the deception is easily discovered, for true gum copal has a "goose skin," as the pitted surface is called. Then, again, the false gum copal melts in the mouth, and the genuine is not soluble even in alcohol. In the office of a Chicago varnish company is a lump of gum copal which weighs 400 pounds, and this is said to be the largest piece ever found. In the cabinet of gums in this office are several specimens of clear gum in which insects have been imprisoned, and it is estimated that those bugs were in those bits of gum copal at least 6,000 years ago.

BEESWAX AND HOW IT IS PREPARED

Since the enterprising chemists and refiners went into active competition with the honey of bees and made a pure, white wax, or paraffin, out of petroleum, the use of beeswax in the manufacture of sperm candles, wax flowers and carbon papers has gone down, but the cobblers, tailors and harnessmakers still stick by the honey bee, and declare that no petroleum wax can equal beeswax when it comes to waxends for slipping through awl-holes. Chemists, artificial flower-makers, laundries and other users of wax have not all gone over to the enemy, as the 500 tons of beeswax consumed annually indicate that the honey bees have hosts of friends left.

But many of these friends require white, or nearly white wax, and the yellow wax made by the bee must first be whitened or bleached before it is put on the market. The sun is the bleacher, so all bleacheries are in the country away from the dirt and smoke of the cities, and usually in the center of large honey districts. The beeswax is sent to the bleaching house in the shape of loaf-cakes, each weighing about twenty-five pounds. These cakes are broken into small pieces and put into a vat or tub made of cedar, about five feet high and three feet across. In the bottom of this vat are two square wooden pipes, crossing each other at right angles. The tops of these pipes have a number of holes bored in them and both are connected with a steam pipe which brings the steam to them at a pressure of about sixty pounds to the square inch. From 1,200 to 1,800 pounds of wax are placed in one vat at a time, and enough water is run in to float the wax. Then the

steam is turned on, and it jets up through the holes in the wooden pipes, melting the wax. The dirt in the wax falls to the bottom of the vat, and the melted wax, about three hours after the steam is turned on, is ready to be drawn from the vat.

Not far from the vat in which the wax is melted is a wooden roller about five feet long and a foot and one-half in diameter. This roller revolves in cold water, and when the melted wax, after first passing through a sieve, falls upon it in narrow ribbons, it chills at once, and, sticking to the roller, is carried around into the water. The roller turns once every second, and when the chilled ribbons of beeswax are carried around into the cooler water they fly off the roller into the water-bed.

From the cooling bed the wax is lifted on wooden forks, placed in boxes, and carried outside to the bleaching beds. These are called frames and stand about three feet above the ground. Each frame is about 100 feet long, 15 feet wide and a foot deep. In each frame half a ton of wax is spread, and there it stays for a month or five weeks, depending on the number of sunny days, for the wax is exposed to the full light of the sun. Several times a day the wax is sprinkled with water to keep the sun from melting it, and once each day two men harrow it with a rake which extends across the frame, so that in the month of bleaching every bit of wax has all of its sides exposed to the sun several times.

At the end of a month the yellow wax has turned a creamy white, and it is then taken back to the melting vat and remelted, run through the screen over the wooden roller, and brought back to the bleaching frames for another stay, this time, however, for only two weeks. By this time the

beeswax is pure white, and is ready to be put into marketable shape. The boys take about 500 pounds of wax and melt it in a small tub. Near the tub is a table on which stand a large number of pans about four inches in diameter and a quarter of an inch deep. The pans are arranged in rows, for the melted wax is poured into one row at a time. Above the pans and across the full width of the table is a movable copper cylinder. It is really a double cylinder, one inside of the other, and the space between the two is filled with hot water. The melted wax is poured into the inside cylinder, and is kept in a liquid shape by the hot water jacket.

A number of small tubes lead from the inner cylinder through the water-jacket, and one valve turns the melted wax into all the tubes, so that the boy who is filling the little pans can move the cylinder along until it is over a row of pans and then can turn the valve and fill the entire row at once. In an hour the wax in the pan-molds is cold and ready to be shipped.



TAR AND ITS USES IN THE SCIENCES

Down in the Carolinas the edges of the hills frown with almost endless forests of great pines, dark and silent. From the size of the trees the casual observer would imagine that they could be used to excellent advantage for the mainmasts of great vessels, or could be cut into lumber with which to build a city. But the "poor white" of the mountains knows better. He has seen the great boles of pines perspire with sticky pitch, and he knows that if they are

cut open the wood will appear pockmarked with endless knots and rotten places. Yet they have a value all their own, and the "poor white" knows how to make the most of it.

In the first place, the trees may be "sapped" for turpentine by making the proper incisions in the trunks, or they may be burned for tar. All through the forests mounds of earth—deserted tar-kilns—may be seen at the center of patches of clearing, and not far away a ruined shanty, where the tar-burner made his home while the firing was going on. The work is eminently adapted to the capabilities of the "poor white," because it enables him to work very hard for a few days in getting the mound made, and then lie about for weeks hunting a little, talking a little, and preparing as elaborate meals as the country will afford until the burning is completed.

Slightly sloping ground on the hillside is usually chosen for the site for burning tar. A hole or basin from sixteen to twenty feet in diameter and three feet deep at the center is scooped out, connecting with a covered trough through which the tar is to flow. The workmen then fell the green pines around them and cut them up, roots and all, into pieces three or four feet long and a few inches in diameter. The "piler" takes these sticks as they are brought to him and stacks them up on end in the shape of an Indian wigwam, one tier above another, until the top dwindles to a point. Sometimes more than 100 cords of wood are heaped in a single hole, the amount depending usually on the energy of the burners. Damp earth and sand are heaped over the completed pile to the depth of several inches, and it is sometimes further covered with green boughs. A flue is made

at the top to furnish the necessary draft, and a number of small holes or dampers are left at the bottom.

When everything is ready the pile is ignited, and as the fire spreads through the wood the apertures at the bottom are gradually closed up and slow combustion goes on for about ten days. It has to be closely watched in order that the fire neither goes out nor burns too fiercely. At the end of the firing period the pile has settled so much that the top caves in and a bright blaze leaps up, only to be extinguished by the addition of more moist earth. About this time the spout at the bottom of the tar-hole begins to trickle with a lazy-moving brown liquid which has a pungent odor. This is the beginning of the tar flow, and is always greeted with much joy by the watchers, who know that their work is beginning to bear fruit. During the first few hours the flow is usually full of sand and charcoal, and it is promptly discarded. As soon as the stream is fairly clear it is run into barrels and allowed to cool, after which it is ready for shipment. About 17.5 per cent of the wood burned is converted into tar, and the flow lasts sometimes for two or three weeks. As high as 150 barrels of tar are taken from a single hole, but to secure so large a product the pile of wood must be very large.

This crude method of burning is exceedingly wasteful, all the gas, the acetic acid, and much charcoal being entirely lost. The tar, when taken from the holes, is usually distilled in retorts, giving off wood spirit and pitch oils. The black residuum is poured while still hot into barrels, where it soon hardens and becomes the ordinary tar of commerce. It is largely used in making tar pavements, tar roofs, tar paper and

in calking ships and sidewalks to make them impervious to water.

This method of procuring tar was formerly much used, but of late years tar is so much more easily obtained as the result of the manufacture of ordinary illuminating gas that it only pays for the "poor whites" to engage in the work. So plentiful, indeed, was coal tar at one time—and that was not so very long ago—that it was almost a waste product. But the process of distillation has now become so perfect, through the discoveries of chemists, and the use of the product thus obtained is so extensive, that almost all the tar is utilized. It is simply astounding what a quantity of things can be made out of the black, foul-smelling substance which the pavement builders use so lavishly on the boulevards. Besides numerous substances which have become household and commercial necessities, dozens of drugs are manufactured from it, so many, in fact, that the ordinary drug store could not do a day's business without having many inquiries for them in some form or other.

In manufacturing these various products the tar is taken from the gas works and allowed to stand for some time in a pond, until the tar water, consisting largely of ammonia, has risen to the top. The tar is then drained away and pumped into a large upright cylinder or still of iron, and heated to a moderate temperature. More water is forced out and drained away, and then the heat is gradually raised.

The first product is a number of highly combustible and poisonous gases which are allowed to escape. Between the temperatures of 105 and 110 degrees, the products distilled are called the "first runnings," which include benzine and benzol,

the uses of which are well known. On raising the temperature to 210 degrees, numerous light oils or benzols are distilled off, and beyond this temperature the carbolic oil appears, and it is removed for the well-known carbolic acid. When the heat gets up to 240 degrees, creosote oil is given off, and it has been found a valuable substance in pickling timber and for various uses in the arts. Above 270 degrees anthracine oil appears, and this product by a separate process is converted into anthracine and numerous other compounds. Naphthalene is distilled off more or less during the whole process, and can be collected in the form of crystals and utilized.

The residue at the end of the distillation is a thick, black liquid, which, upon drying, hardens and becomes as brittle as glass. It is then known as "hard pitch," and upon melting it again, with possibly the addition of the creosote and anthracine oils, from which all the valuable parts have been removed, it is used extensively in making asphalt pavements. In such form it is familiar to the average citizen. By dissolving this hard pitch in certain tar oils, various varnishes are made, and by burning it until all the volatile parts have disappeared it becomes a high quality of coke, much used in the better class of metal working. Lamp-black may also be made by subjecting the tar to a partial combustion on hot-iron plates and conveying the smoke into cool chimneys, where it deposits its carbon.

Among the drugs which are the result of the distillation of tar are antipyrine, which became popular during the epidemic of "grip" that swept over the country a few years ago, and antifebrin, which is made from the acetic acid and aniline oil. Acet-

anilid is used by some physicians in preference to antipyrine, for the reason that the smaller doses of it accomplish the same purpose as larger doses of the other drug. Phenacetine and saccharin are two other products of tar. Saccharin is 280 times sweeter than sugar, so that a single grain of it will sweeten a cup of coffee without the slightest difficulty. It is used principally in treating gout and diabetes.

Another product, sulphonal, is used in treating mental diseases. Its real scientific name is diethylsulphondimethylmethan, and the patient may consider that he has fully recovered his brain power when he can pronounce it correctly and fluently. The action of sulphonal in common with a number of other tar drugs is hypnotic, causing a quiet, restful sleep in cases of insomnia caused by worry, fatigue, or even dementia and acute alcoholism. Besides those named there are scores of other drugs produced by the distillation of tar, all of them well known to the medical profession.

Salophen is a compound of carbolic acid with a number of other ingredients. It is said to be a valuable remedy in the treatment of articular rheumatism. The very latest in the long line of coal-tar products is gallanol. It is prepared by boiling tannin with aniline. It is introduced as a substitute for pyrogallie acid, having the advantage of being non-toxic and non-irritant. In the treatment of skin diseases it has been used with marked success. Cazeneuve, the introducer of the drug, reports that one of its principal uses is in the treatment of psoriasis by painting the spots with gallanol suspended in chloroform and covering them with a solution of gutta percha in chloroform.

The making of dyes and colors from tar

products has become an important industry in the last few years. Any color or shade can be exactly reproduced in a beautiful and lasting form, and new combinations are being discovered every year by the chemists.



TURPENTINE AND RESIN

Dialect writers find a fruitful field among the "tar-heels" of the Carolinas, Alabama and Georgia. In the cool depths of the turpentine woods, with the gashed trees yielding up their resinous gum, the balmy air and the picturesque "hackers," "dippers" and "scrapers," with the ever-vigilant "rider" watching everything, is a phase in southern life which has long been the delight of authors and the pleasure of the artists. The crudity of the implements and the stills used in the making of turpentine and resin lends additional interest to this old industry, and the gypsy-like habits of the turpentine-makers add to their ragged, illiterate charms.

Turpentine is the distilled gum of the pine trees of North and South Carolina, Alabama, Georgia and part of Florida. The season begins when the first spring sap rises and ends when cold weather checks the flow of the tree's blood. In January or February the "hacker," with his keen-bladed ax, begins the round which ends with the season. He is the expert of the woods and knows his trees, and just how much hacking they will stand. His task is to cut the "boxes" in which the thick gum of the wounded tree will collect. A box is a wide incision about six inches deep, a wedge-shaped cut in the tree, and he hacks from 90 to 100 boxes a day. The first

boxes are cut near the roots of the tree, and they are cut as close together, to the height of a man's head, as can be done without killing the pine. The hacker leaves a width of bark between each box, so as to preserve the vitality of the tree. When the trees are leased to the turpentine-makers the terms of the lease limit the number of boxes to each tree, but when it is desired to work the pine to the fullest extent the gashes are carried up to a height of twenty feet or more.

After the hacker comes the man who "corners" the boxes. This "corner" is a cut in the top of the box, to guide the sap into the cavities left for the gum, and the man who "works" the "crop" goes systematically from box to box, starting the sap anew with fresh incisions, working in this way 10,000 boxes during the season. The sap or gum fills the boxes with a clear, sticky, thick fluid, and this is removed by the "dipper." Scattered through the woods are barrels in which the "dipper" deposits the gum, which is then hauled to the still. About a quart of sap is taken from each box by means of the trowel-shaped scoop used by the dipper, and then the hacker comes along and starts the flow afresh by wounding the tree again. The turpentine-maker watches his men closely, for the tarheels are an easy-going people and require to be urged by the "rider," who goes through the woods on horseback, examining the crop, hurrying the dippers and hackers, and sending the barreled gum to the still.

The first or "virgin" sap, which flows in the spring, makes the best resin, and the poorest is the product of the hardened gum which is left on the sides of the boxes when the sap "turns down" in the fall. This is removed by the "scraper," who moves

through the woods with his scraping tool, gathering the leavings.

The still is a large copper vat, hooded with a close-fitting air-tight cover, in which is a funnel which in turn is connected with the worm of the still. The worm runs down into another vat near at hand, and in this vat the fumes or vapors of the heated gum are distilled into turpentine. Fire under the copper heats the gum, and the volatile parts rise to the funnel, pass into the still and are condensed by the water in the second vat into spirits of turpentine. The residuum left in the vat is the resin of commerce, which is passed through a series of strainers and sieves to the barrels, which are made on the spot. The turpentine, however, cannot be barreled so easily, for it will work through an ordinary barrel. It is placed in white pine barrels, which have been coated inside with several coats of strong, hot glue, until the barrel is impervious to the subtle fluid.

The trees are worked for five or six seasons, and then the turpentine-maker moves to another part of the woods. He started in North Carolina, crossed over to South Carolina, and is still moving toward the gulf. Forest fires destroy the pines faster than the hacker does, for the inflammable trees catch the sparks readily, and the flames sweep over the large areas before they die out. Careful owners of turpentine woods have the pine straw and fallen underbrush raked away from their trees before the season begins, and, collecting this material in some safe spot, wait for a quiet day, when there is no wind, and then they burn the rakings.

Negroes are the common laborers of the turpentine woods, but white men are plentiful. They live in rough shanties in the

woods, with the stables for mules and horses near at hand. No work is more healthful than turpentine making, for it is all out of doors in the depths of the balmy, health-giving pines, free from the malaria of the swamps and from sudden changes of weather.

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DYES FROM COAL

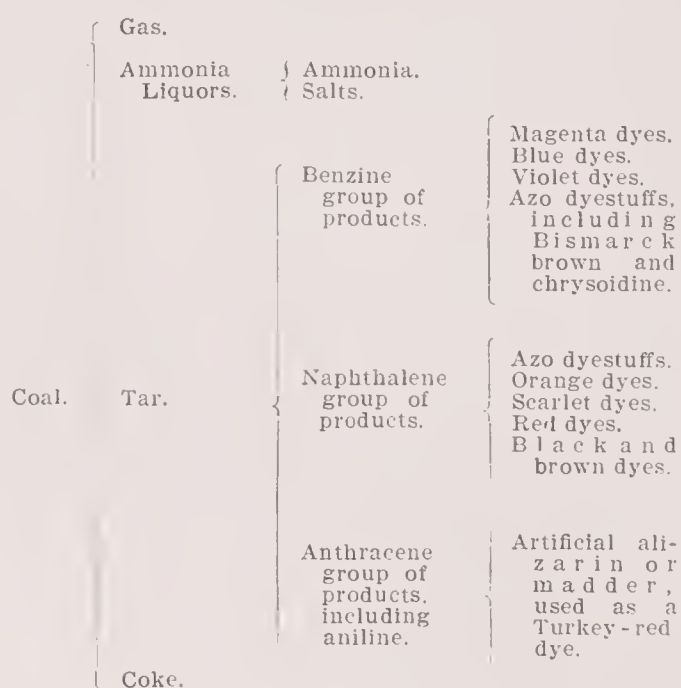
Not many women know that the beautiful reds, blues, greens and browns in their dresses are made from the substance which glows in their coal-heaters.

It was not so many years ago that cochineal and madder furnished the reds, logwood the black and indigo the blues, and the expense of dyeing was sometimes almost equal to the cost of the fabrics. But that was before chemists had begun to examine coal and its products. Everybody knew that coal could be burned, and that was the end of it. No one thought of the wonderful substances which nature had fastened up in the little black lumps. At last an experimenter discovered how to make gas for illuminating purposes, and as soon as the process began to be generally used it was noticed that a brownish, pungent-odored syrup, which bore a strong resemblance to wood tar, flowed away as a troublesome by-product. After a time the scientists named it coal-tar, and then began to pick it to pieces. Marvelous substances were extracted, one after another, in quick succession, until now the number reaches well up toward one hundred, and nearly all of them can be converted into beautiful dyes.

The first of these—aniline, which is now a common commodity—was brought out in 1858 by a man named Perkins, and a number of rich mauve and purple dyes were

made from it. Within a dozen years scores of patents were taken out for all sorts of coloring compounds made from tar products. To-day the vegetable and animal colors, with the possible exception of logwood, have almost wholly given place to the mineral products from coal-tar, and the cost of dyeing has become far cheaper.

Some idea of the products from coal may be had from the following diagram:



The red, the blue and the yellow are regarded by dyers as the primary colors, and, by mixing them in various proportions, almost any color can be made. The combination of all three colors gives black. Indeed, coal-tar colors are practically innumerable, and a number of great business concerns are engaged in producing them in convenient forms for the use of dyers.

In most cities where fabrics are not made to any great extent the business of dyeing is conducted mainly by small concerns, which are rather renovating establishments than dye-houses. Here faded goods, curtains, draperies and all manner of dress fabrics are recolored beautifully. The

woman who has a gown of faded blue silk and concludes that she would like it better if it were a deep wine-color sends it to a dye-house. Here it is ripped apart with great care, and all the dust and grease are carefully beaten and washed out of it. Then it goes through the various liquids of the process and comes out with a beautiful new color.

The exact principle of dyeing is difficult to explain. Scientists are not yet quite agreed whether the action on the fabric fibers is chemical or only physical. Besides this it is not known why some varieties of dyes will stick by simply being poured over the fabric while others will color only those fabrics which have been prepared with a mordant. The first of these two kinds of dyestuffs are some of the aniline colors. The whole process consists simply in placing the dye in a big kettle with water, using enough of it to produce the required shade, and when the solution is hot, dipping the fabric into it. After a thorough stirring the fibers take up all the color, and the liquid left in the kettle is almost colorless.

But the great majority of dyes belong to the second class, those requiring mordants. In the original meaning the word mordant was applied to an adhesive composition for attaching gold-leaf to wood or metal, and it was appropriated by the early dyers to designate a chemical which would fasten coloring matter to the fibers of a fabric. Mordants are of a great many kinds. For "setting" certain kinds of purple dyes on cotton, sumac or any other form of tannic acid, combined with salts of tin or tartar emetic, is commonly used.

The dyeing process, while it is extremely simple, requires a good deal of caution and

experience. If the cotton is unbleached it must be bleached, and this is usually done by washing it first in a slightly alkaline solution, which is kept boiling furiously. When the cloth comes out it is clean, but still of a brownish-gray color. It goes then to the "chemical-box," where it lies three or four hours in a solution of chloride of lime, where it becomes as white as snow. The chloride is neutralized by dilute sulphuric acid, and the cloth is then ready for the dye-room.

Here it goes to a big tin tank filled with the mordant. The tank must be all tin, for if any copper or iron comes in contact with the cloth a stain will be the result. After remaining half an hour in the bath the cotton is taken out, washed and rinsed, and if necessary a little ammonia is added to neutralize the free acids, and then it goes to the dye vat. It takes great skill to determine just how much color will dye a given fabric to the desired shade, and the cloth must not remain in the vat too long. It is then taken out and usually passed through a solution of scrap soda to fix the colors, after which it is dried.

Wool as it comes to the factory is first washed and scoured to remove the grease, alkaline salts and earthy impurities, and it is then bleached with dilute sulphuric acid. If hot solutions of caustic alkali were used, as in the case of cotton, the wool would be dissolved. After this cleaning it may be dyed, or woven and dyed afterward. In either case it is boiled in the salts of tin solution and then goes to the color vat.

Red liquor or acetate of aluminum is frequently used as a mordant, giving bright shades when used with certain alkaline colors. Turkey red oil, two to five pounds

to the gallon of water, is also a good mordant.

Cochineal and madder reds, indigo blues of all shades, the use of which in dyeing was a complicated process, and fustic, quercitron bark and Persian berry yellow, have been mostly superseded by coal-tar colors. Logwood black is still used.



CARBON BLACK AND ITS USES

Few readers of books and papers have any very clear idea of the source of the black substance from which the ink used in printing is made. The general idea is that it is lampblack, the sort produced in burning resin, turpentine or crude oil with an insufficient air supply. Up to ten years ago this was the base of all the ink used, but since the wide development of natural gas, lampblack has been mainly superseded in good ink by a very superior article known as carbon black. This is made entirely from natural gas in the gas region of Pennsylvania, Ohio and Indiana.

The factory for its manufacture is a very simple affair, consisting of a long, low wooden building, through the whole length of which run double rows of gas pipe, eight to ten inches apart. These have either holes drilled in them every ten to twelve inches, or small tips, such as are used in house jets, set in at about the same distance, from which the gas burns. Above each of these double rows of jets is placed a long, narrow sheet-iron pan about four inches deep.

A stream of water covering the bottom of the pan is kept flowing steadily by means of pumps. The jets are lighted and the big flames play up against the pan, "smoking

it," as a piece of cold tin held above the gas jet would be smoked. Very little air is allowed to enter, and as the water keeps the pan comparatively cool the deposit of soot is heavy.

About every half hour a sheet-iron car with a scraper above it is drawn under the pan its whole length, scraping off and collecting the carbon black. These cars work in pairs, the cars of two lines of jets being drawn by the same wire rope. As one goes to the lower end of the building, the other comes to the upper end. The rope is wrapped around a drum operated by an engine.

When the car is full it is emptied into a large trough, and the black, which is somewhat damp, is taken to the dryer, a broad shallow pan with a fire beneath. When dry the lumps are crushed. The substance is then bolted or sifted, coming out as fine as flour, and is finally packed in barrels lined with paper bags to prevent sifting out.

The product is almost pure carbon, of an intense black and very light. A barrel of it packed under a screw weighs only fifty pounds. It is so much blacker than lampblack, which has a grayish tinge, that it has two and a half times the value of the latter in producing a given depth of color. That is, one weight of it will produce the same depth that two and a half times its weight of lampblack will produce. It is also very free from the fault of packing and sticking together. To these last two properties it owes its great value as an inkmaker, producing a very brilliant black ink that runs freely and is less pasty and sticky than that from lampblack.

Besides being used in inks, carbon black enters into the composition of black paints, varnishes and lacquers, gives brilliancy to

stove-polishes, and forms the body of the best shoe-blackening. A large quantity—perhaps 50 per cent of all that is made—is shipped abroad.



PEARLS FROM AMERICAN RIVERS

We think ordinarily of pearls as rare and precious products of the orient or the south-

Fish Commissioners prepared a report on the subject, from which in part the following facts are drawn.

Pearls consist of carbonate of lime, interstratified with animal membrane, found in the shells of certain mollusks. They are believed to be the result of an abnormal secretory process caused by an irritation of the mollusk from an accident, disease, or the intrusion into the shell of some foreign body, as a grain of sand, an egg of the mol-



PEARL FISHERMEN AT WORK ON A WISCONSIN RIVER.

ern oceans, where dusky native divers bring from the depths of the sea the treasured shells wherein are concealed the gems which are to shine in some costly necklace. Yet within the last few years an industry of great importance and profit has grown up in the fresh water pearl fisheries of our own country. So widespread has been the interest in this subject that the United States

lusk itself, or a parasite. They may occur in almost any molluscan shells, though chiefly confined to certain species, and their color and luster depend upon those of the interior of the shell next to which they are formed. Thus the pink conch of the West Indies yields the beautiful rose-colored pearls, while those of the common oyster and clam are dead white or dark purple.

The true pearl oyster, found in the Pacific and Indian oceans, yields the bulk of commercial pearls. Many rivers, however, in South America, Europe and North America, support species which produce beautiful and valuable pearls, and it is in the Mississippi valley that the production of late has become so important.

Pearls are of several distinct kinds, differing in shape and perhaps in origin. These are first what are known as free pearls—those that are found loose and separate from the shell. Then there are those which lie against the shell or are attached to it, very irregular in shape. As many as a hundred small pearls have been found in a single shell, but as a rule these have little or no value. All these varied kinds are found in the marine pearl oysters as well, but the fresh water mollusks have the additional beauty of great variety of tints and of partial transparency in their “nacre,” as the pearl material is called. From very early historical times pearls have been sought and found in river mollusks. Scotland, England, Ireland, Mesopotamia, Saxony and Bavaria are countries known in this connection.

It has long been the habit of the Chinese to produce artificial pearl objects by introducing little flat metallic figures, usually images of Buddha, between the valves and the mantle of a large river mussel of that country. These little figures are inserted carefully so as not to injure the animal, which is then returned to the water and left for some months or a year. When again dredged up and opened, the figures are found to be entirely coated over with the pearly material, and slightly attached thereby to the inner surface of the valve. They may then be easily removed and used for

ornaments or charms. The Chinese also sometimes insert strings of small beads, which become apparently pearls, and carry out this same method by other ingenious devices.

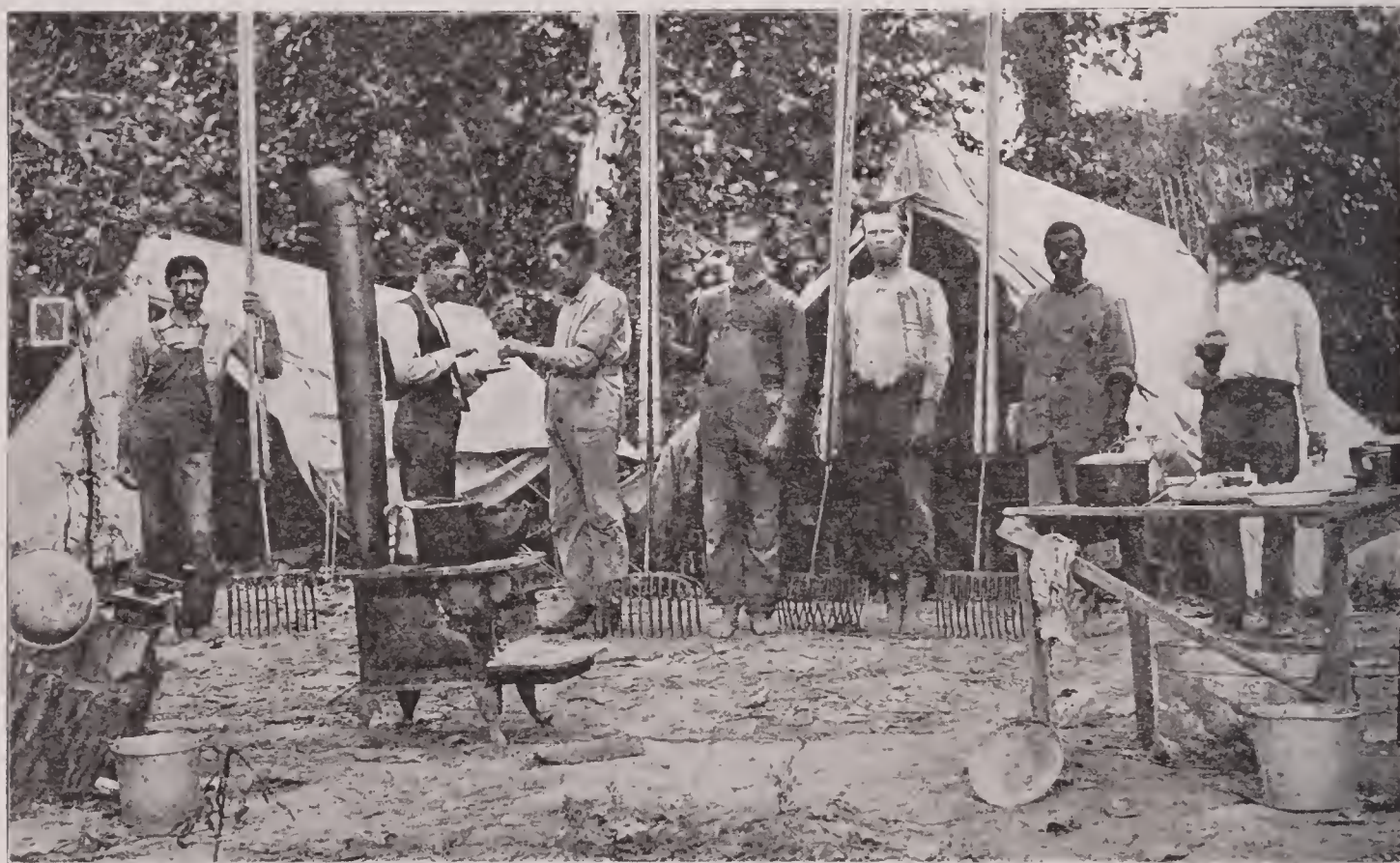
That so few American conchologists have paid attention to American pearls is perhaps accounted for by the fact that they are found more frequently in old, distorted and diseased shells, which are not so desirable for collections as the finer specimens. Collectors who have opened many thousands of Unios have never observed a pearl of value. Pearls are usually found either by farmers who devote their spare time to this industry and, if no result is obtained, suffer no loss, or by persons in country villages who are without regular occupation, but are ever seeking means for rapid increase of fortune. The general method of collecting shells in the most primitive manner is for boys and men to wade into the mill race or into the river to their necks, feeling for the sharp ends of the Unio shell which always project. When one is discovered, the finder either dives after it or lifts it with his feet.

It was the custom formerly to open the shells in the water, and once during the process a pearl as large as a pigeon's egg is said to have been dropped into the water and was never recovered. Multitudes of shells that do not contain pearls are destroyed. Many brooks and rivers have been completely raked and scraped, often in a reckless manner, and consequently with little result. This wholesale destruction has no doubt exhausted many varieties of these shells, together with the depredations of hogs, which have exterminated whole shoals of Unios when the brooks were low, and impurities introduced into the water by

manufactories. The eastern states are so densely populated, and the streams so contaminated with refuse and sewage from factories, that animal life is rapidly disappearing from the watercourses in many localities.

Although the gathering of pearls from the fresh-water shells of North America is a matter of comparatively recent date among the present inhabitants, it really

Jersey. It became known as the "Queen pearl" and was sold to the Empress Eugenie of France for \$2,500. It is to-day worth four times that amount. The news of this sale created such an excitement that search for pearls was started throughout the country. The Unios at Notch Brook and elsewhere were gathered by the million and destroyed, often with little or no result. A large round pearl, weighing 400 grains,



GROUP OF PEARL FISHERMEN IN CAMP.

Showing the long-handled tongs with which the shells are drawn from the bottom of the rivers.

goes back very far into the unrecorded past. The first European explorers speak frequently of the number and beauty of the pearls in the possession of the natives. No particular attention, however, was given to the subject in the United States until about forty years ago.

In 1857 a pearl of fine luster, weighing 93 grains, was found at Notch Brook, New

which doubtless would have been the finest pearl of modern times, was ruined by boiling to open the shell. Within one year pearls were sent to the New York market from nearly every state—in 1857 fully \$15,000 worth. The excitement gradually abated, however, until in 1868 there was a slight revival of interest, and many fine pearls were obtained from the Little Miami

river, Ohio. Some of the finest American pearls came from near Waynesville, Ohio, in 1876. Since 1880 pearls have come from comparatively new districts farther west and south, Kentucky, Tennessee, Texas and Florida first contributing to the supply.

Next the interest extended to the northwest. During the summer of 1889 a quantity of magnificently colored pearls were found in the creeks and rivers of Wisconsin.

duced nearly \$500,000 worth of pearls since 1889.

The northwestern pearl excitement subsided in a few seasons, as the others had done in turn before, by the exhaustion of the mussel beds. About every ten years or so a new wave of interest rises in connection with fresh discoveries, at some point where the shells have lain long undisturbed; it again absorbs the attention and excites



A BARGE LOAD OF PEARL SHELLS.

The gathering of shells from the rivers of the upper Mississippi valley has become an industry of great magnitude. Such cargoes of shells are brought to the button mills, and buttons are made out of them, after the search for pearls has been completed.

sin. Of these more than \$10,000 worth were sent to New York within three months, including one worth \$500, and some were equal to any ever found for beauty and coloring. These discoveries led to immense activity in pearl hunting through all the streams of the region, and in three or four seasons the shells were almost exterminated. Wisconsin has pro-

duced the imagination of the country around, and spreads to other parts of the country; a fresh campaign of ignorant extermination is carried on for several summers, then the yield is exhausted, and there is nothing more but to leave nature to recuperate, if possible, and slowly to restore, in limited amount, the abundant life that has been destroyed.

In 1897 Arkansas developed a rich yield of pearls, and the excitement extended to Indian Territory, Missouri, Georgia, Tennessee and Kentucky. In fact hardly a state has been exempt from a period of excitement over pearl discoveries. The upper Mississippi valley, of late years, has proved to be a fruitful field for the pearl fishers. Streams in Iowa, Illinois and Wisconsin have been worked with great regularity and large profit. Farmers' wives and daughters, as well as the men of the families, have shared in the search of the streams flowing into the Mississippi.

Along the Mississippi river several large factories have been established for the making of buttons and ornaments from the beautiful pearl shell of the mussels. The largest of these are at Muscatine, Davenport and Sabula, and at Cedar Rapids, on the Cedar river. In the past the valuable material has been entirely wasted in the search for pearls.

The shells are most abundant in swift and clear water, where the bottom is sandy or gravelly and the country rock calcareous. While still numerous in many streams, they have greatly diminished within a few years past, wherever the pearl-hunting enterprise has extended, and are at some points nearly exterminated. The pearls found are few, and those of marketable value represent the destruction of thousands of shells for every pearl obtained. The wealth of Unios that fills our rivers and streams is rapidly being destroyed by ignorant and wasteful methods of pearl hunting. Either some form of protection is important, or if that be not possible, a diffusion of information as to better methods and the introduction of the tools used in Germany for opening the

shells far enough to see if there are pearls contained without destroying the animal, which may then be returned to the water.



PRECIOUS STONES, REAL AND ARTIFICIAL

A recent conversation with Mr. Kunz of Tiffany's on attempts that have been made to produce artificial rubies and diamonds and on other subjects relating to precious stones, elicited the following information:

"In 1888 quantities of artificial rubies were sold in Paris," said Mr. Kunz. "They were readily distinguished from the genuine by experts because of tints of color peculiar to them, and by the presence of round bubbles, proving them to be of igneous origin. Quite a number got into the New York market before they were discovered, and several dealers in gems were bitten. The Paris jewelers at first insisted on the arrest of the swindlers, but the latter returned the 800,000 francs they had been paid for the bogus rubies, and the gems must now be sold as artificial, and not as real, under the penalty of the law. I described the difference at that time before the Academy of Science, and received letters from the other side inviting my co-operation in floating the artificial stones, which are still occasionally sold as real rubies.

"They were made by fusing an aluminate of lead with a silicate and bichromate of potash. The color was very good. A buyer sent to Ceylon for sapphires once was cleverly deceived in the matter of color by being shown sapphires in the blue room, where they appeared to be of a decidedly blue tint; but when he got them out of the

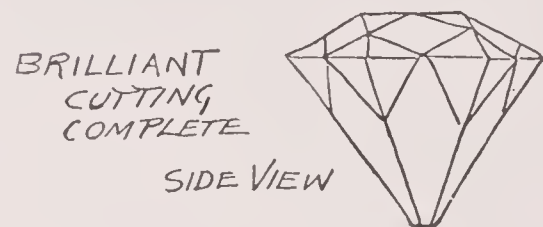
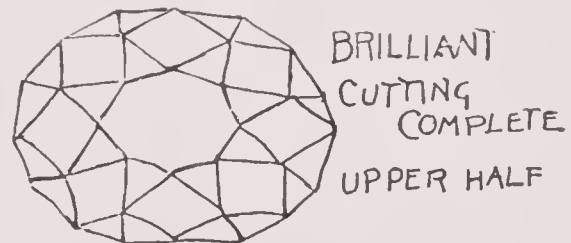
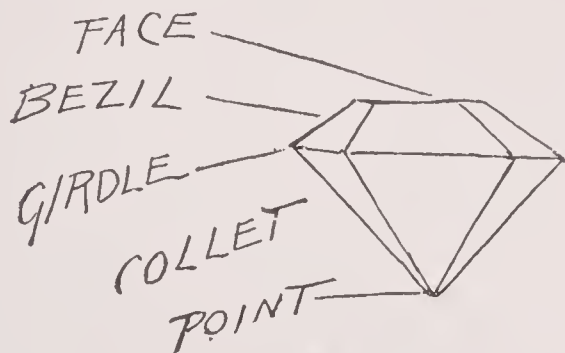
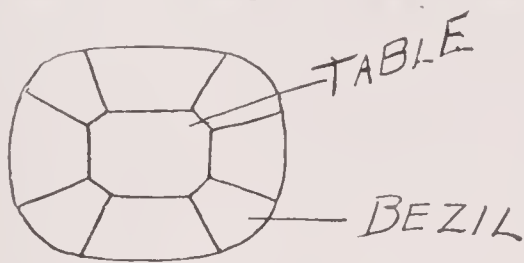
blue room their tint was gone. Dealers often place stones before mirrors which throw light through them. A diamond in no place looks so well as before a mirror with candles. An electric light is stationary, but the flicker of the candles gives the stone unnatural brilliance."

"Didn't Mr. Edison once attempt to make artificial diamonds?"

"Yes, and rubies and sapphires, and there was so much talk about it in the public press that I wrote to ask him whether his results were satisfactory. He responded as follows: 'The experiments to which

far as it relates to the subject of artificial diamonds, they never having produced any. Therefore another reputed artificial diamond discovery has been withdrawn.

"An impression seems to prevail that a diamond will not break if struck with a hammer on an anvil, and more than one fine stone has been shattered in attempted tests, thus proving the fallacy of the assertion. While the diamond is very hard, it is also very brittle and can easily be broken, and, although every substance from the hardness of feldspar up—including a cleavage or cut diamond—will scratch glass.



DIAMOND CUTTING AND ITS TECHNICALITIES.

you refer were given up because it was found impossible to produce stones free from bubbles, which render them useless for cutting edges.' This referred to their use as points for the phonograph, but the same objection would render them valueless as gems. In reference to a published statement that the Cowles Electric Smelting and Aluminum Company is suffering an infringement on its patent for making artificial diamonds by means of an electric furnace, Mr. Cowles, the inventor, informs me that the statement is incorrect, in so

nothing but the natural edge of a diamond crystal will cut it. If a stone will scratch corundum and is not scratched by a diamond, it is safe to assume that it is a diamond. It is well to make the trial on a smooth or polished surface, otherwise the scratch will not be perceptible.

"The largest diamond mine in the world," continued Mr. Kunz, in reply to a further inquiry, "is owned by the De Beers Mining Company at Kimberley, South Africa. The stock of that company now amounts to about £20,000,000, or

\$100,000,000, and since the company was organized it has found 38,000,000 carats of diamonds, weighing over nine tons. In the rough they were worth more than \$250,000,000, and after cutting, over \$600,000,000, which is more than the entire yield of the world during the preceding two centuries, but of the whole product not more than 8 per cent can be said to be of the first water, 12 per cent of the second water, and 25 per cent of the third water, while the remaining 55 per cent is called bort, a substance which, when crushed to powder, is used for engraving and cutting hard substances. This bort, however, must not be confused with the bort-carbon (carbonade) found in Brazil, an incrySTALLINE form of the diamond which, from its structure, is adapted for use in drills for boring and tunneling rocks. It has never been found in South Africa, and is worth from six to ten times as much as bort."

"What was the most important diamond found in South Africa?"

"I should say the Victoria or Imperial diamond. The original crystal weighed $457\frac{1}{2}$ carats, or over three ounces Troy. Strange to say, although this is the largest diamond of modern times, its early history is very obscure. It is reported that the stone was found in the Kimberley mines in the month of July, 1884, by a mining inspector, and sold by him to some illicit diamond buyers, and afterwards to a syndicate of European dealers. The stone has been cut, and in its finished condition weighs 100 carats. It is a beautiful, perfect steel-blue diamond, and the largest white brilliant known. It is valued at \$200,000. Among some other large diamonds may be mentioned the Du Toit, which weighed 244

carats when found; the Jagersfontein, 209 $\frac{1}{4}$ carats; the Tiffany yellow, weighing 125 3-8 carats after cutting; the Great Orange, 110 carats; the Porter Rhodes, weighing 60 carats after cutting; the Dudley, 46 $\frac{1}{2}$ carats, and a number of others. More diamonds weighing over 75 carats after cutting have been found in the African mines than were ever before known.

"There was a question at one time whether the Kimberley mines could be profitably worked at all, because from one-fifth to one-quarter of all the yield, it was estimated, never reached the proper owners. The native diggers swallowed and concealed the diamonds in every possible way. It became necessary for the companies, in self-defense, to take extraordinary precautions against this great loss. Overseers or special searchers were appointed, who made the most thorough examination of all who left the mines. The natives use very ingenious methods for the concealment of the gems. On one occasion some officers, suspecting that a Kaffir had stolen diamonds, gave chase and caught up with him just after he had shot one of his oxen. No diamonds were found upon the Kaffir, it is needless to say, for he had charged his gun with them, and after the disappearance of the officers dug them out of his dead ox. Diamonds have been fed to chickens and a post-mortem examination held a few years ago over the body of a Kaffir revealed the fact that death had been caused by a sixty carat diamond which he had swallowed. Early in the history of the mines a detective force consisting of men, women and children was formed, and the severest punishment is still inflicted on transgressors of the diamond act.

"None but those authorized by law, termed patented agents, less than fifty in number, are allowed to purchase or even to possess rough diamonds at Kimberley. The loss would not have been so great but for the irregular diamond buyers, 'I. D. B.'s,' as the 'fences' are called, who lowered the price of stones by underselling the companies in the London market."

"Have any diamonds been found in the United States?"

"Yes, frequently; but none of great value. The occurrence of diamonds in the United States is chiefly confined to two regions, geographically very remote and geologically quite dissimilar. The first is a belt of country lying along the eastern base of the southern Alleghenies, from Virginia to Georgia, while the other extends along the western base of the Sierra Nevada and Cascade ranges in northern California and southern Oregon. In both cases the mode of occurrence has several marked resemblances. The diamonds are found in loose material, among deposits of gravel and earth, and are associated with garnets, zircons, iron sands, monazite, anatase, and particularly with gold, in the search for which they have usually been discovered. This resemblance is due altogether to the fact that these loose deposits, in both regions, are merely the debris of the crystalline rocks of the adjacent mountains and therefore present a general similarity, while the ages of the rocks themselves are widely different.

"The finding of a twin crystal of diamond weighing four and one-third carats at Dysartville, N. C., a three-carat stone near Atlanta, Ga., and a three-eighths-carat stone at Montpelier, Adair County, Ky., are worthy of mention in connection with

the finding of diamonds in the southern states.

"During the year 1893, several interesting discoveries of diamonds were made in the United States. In December my attention was called by Prof. William H. Hobbs, professor of mineralogy and metallurgy in the University of Wisconsin, at Madison, to a diamond that had been found in Oregon township, two and a half miles southwest of Oregon village, in Dane County, Wisconsin. Through his courtesy the stone was sent to me by the finder, Mr. Charles Devine, of the place just named. The diamond was found by him while husking corn in October, 1893, in a rough stony field, which had been under the plough for forty years. The bank of clayey earth in which it was found contained a large number of rounded pebbles of quartz, but no other of the associated minerals of diamond, and as the entire district consists of glacial drift coming from the north a diamond bed is not likely to exist in the immediate vicinity, but is rather to be looked for in the direction from which the drift came.

"The diamond is a rhombic dodecahedron, deeply pitted with circular, elongated, reniform markings. In color it is slightly grayish-green. But it is one of those diamonds in which the color is likely to be superficial, and it would probably cut into a white gem. Its weight is 3 14-16 carats. This is the second authentic occurrence of diamonds in Wisconsin, the other being at Plum Creek, Pearey county, of three small stones, the largest of which weighed 25-32 carat. A 16-carat diamond was reported to have been found, also in glacial drift, at Waukesha, Wis., in 1884. Some litigation resulted from its finding, and considerable

doubt was expressed at the time as to the genuineness of the discovery.

"A small elongated crystal seven millimeters long and four millimeters in diameter, weighing three-fourths of a carat, and of a bright, light canary color, with polished surfaces, was found in the vicinity of King's mountain, North Carolina, during the summer of 1893. Mr. H. S. Durden, of the California State Mining Bureau, reports that two small diamonds were obtained in 1892 and 1893 at Cherokee, Butte county, Cal. One weighed two carats."

"What do you mean by the expression 'first water'?"

"The expression 'first water' when applied to a diamond denotes that it is free from all traces of color, blemish, flaw or other imperfection, and that its brilliancy is perfect. It is, however, frequently applied to stones not quite perfect, but the best that the dealer has, and they may be only of second quality. It is almost impossible to value a diamond by its weight only. Color, brilliancy, cutting and the general perfection of the stone have all to be taken into account. Of two stones, both flawless and of the same weight, one may be worth \$600 and the other \$12,000. Exceptional stones often bring unusual prices, while 'off-color' stones sell for from \$60 to \$100 a carat, regardless of size. The poor qualities have depreciated so much in value that some are worth only from one-tenth to one-fourth what they were worth twenty years ago. This is specially true of large stones of the second or third quality."

"Are rubies worth more than diamonds?"

"Yes, the finest pigeon-blood colored rubies found near Mandalay, Burma, are worth from five to ten times the value of diamonds

of equal weight. The acquisition of these Burmese ruby mines cost the British government a vast sum of money. On the wars of 1826 and 1852 England expended \$75,000,000 and \$15,000,000 respectively; and after all that sacrifice of treasure the Burma and Bombay Trading company claimed that King Thebaw of Burma had arbitrarily revoked the leases by which the company controlled the output of the ruby mines near Mandalay.

"The war of 1886, which followed, involved the raising of an army of 30,000 men and an outlay of \$5,000,000, but the British government gained control of the long-coveted ruby mines. The question next presented was, how should they be worked? Several firms were desirous of securing a lease, and after the Indian government had virtually closed with Messrs. Streeter & Co., the London jewelers, at an annual rental of four lakhs of rupees (£40,000) for a term of five and a half years it was at first revoked, but after a time was given to Messrs. Streeter & Co., who organized the company known as the Burma Ruby mines (limited), and sent a force of engineers and a quantity of machinery to Burma.

"The ruby mines of Burma are situated in the valley of Magok, fifty-one miles from the bank of the Irrawaddy river and about seventy-five miles north of Mandalay, at an altitude of 4,200 feet. Concerning these mines very little was known, as they were always the monopoly of the crown and jealously guarded. It was said that they paid King Thebaw's government 100,000 rupees per annum, and one year 150,000 rupees. Mining was carried on by forty or fifty wealthy natives, who employed the poorer townspeople at liberal wages. All

the gems were sent to Ruby hall, Mandalay, to be valued.

"One thing at least we learned from the British occupation of Burma, which is, that King Thebaw did not own the dishes of rubies which were said to rival anything known. An examination of the jewels, now deposited at the India museum at South Kensington, proved that there was only one cabochon ruby of fair, not fine, quality, and several polished sections of large inferior crystals of emeralds, of any value among his entire crown jewels.

"In 1882 a very remarkable discovery of sapphire was made in the Zenskar range of the northwestern Kashmir Himalayas, near the line of perpetual snow. A landslide removed an abundance of sapphires which were first used as gun-flints by the natives. One writer speaks of having seen about a hundredweight of them in the possession of a single native. Traders, however, soon carried them to the distant commercial centers, where their value became known. There was an instant rush of jewelers' agents to the locality of the mine, and the price rose rapidly until about £20 an ounce was paid for the rough sapphires.

"The Maharajah of Cashmere promptly exercised his authority and sent a regiment of Sepoys to take possession of the mines, and harry the natives, who were suspected of having stones in their possession, or knowledge of new localities where the gems could be found. Any one who had money was suspected of either having sold sapphires or being about to purchase them, and was despoiled and even imprisoned. This naturally had the effect of compelling secrecy. Several crystals were found weighing 100 to 300 carats each.

"Public interest in semi-precious stones has

increased greatly during the last few years. Formerly jewelers sold only diamonds, rubies, sapphires, emeralds, pearls, garnets and agates, but at present it is not unusual for almost any of the mineralogical gems, such as zircon, asteria, or star sapphire or star ruby, tourmaline, spinel or titanite to be called for, not only by collectors, but by the public, whose taste has advanced in the matter of precious stones as well as in the fine arts.

"Cat's eyes came into fashion when the Duke of Connaught gave his bride an engagement ring set with one. The best cat's eyes come from Ceylon and Siberia. Moonstones were discovered in the province of Canda, Ceylon, during the search for cat's eyes, and they have been so popular that at least 100,000 have been sold in this country within four years."



VALUE OF DIAMONDS

Diamonds averaging one-half carat each, \$60 per carat.

Diamonds averaging three-quarters carat each, \$80 per carat.

Diamonds averaging one carat each, \$100 per carat.

Diamonds averaging one and one-quarter carats each, \$110 per carat.

Diamonds averaging one and one-half carats each, \$120 per carat.

Diamonds averaging one and three-quarters carats each, \$145 per carat.

Diamonds averaging two carats each, \$175 per carat.

In other words, the value of the gem increases in the geometrical ratio of its weight. Four diamonds weighing together two carats are worth \$120; but one dia-

mond weighing just as much is worth \$350. Stones weighing over two carats are about the same price per carat as two-carat stones; they should be dearer, but they are not, simply because the demand for them is limited. If the demand for diamonds were as imperative as the demand for flour or beef, the geometrical ratio would again come into play, and five-carat stones would be valued in the thousands.



HOW SHEET MUSIC IS PRINTED

Millions sing popular songs, but few know what a page of music represents. Just to give an idea of the subject, it may be put down in the outset that an ordinary "piece" of three sheets, selling, say, for 10 cents, involves the use of more than 5,000 separate types.

Chicago is one of the great musical publishing centers of the country, and its daily output ranges through all the grades of vocal and instrumental literature, from the symphony for full orchestra, reproduced for the first time from the manuscript of the Chicago composer, to the cheapest reprint of the newest thing in concert-hall music. Woman is on an equality with man in this department of the publishing trade. She commands a man's wages for the "composition" and, as the work is of the most delicate and annoying kind, her patience and dexterity usually give her an easy superiority over the men of the guild.

A composer with a piece of music to publish has his choice among four kinds of printing. If he be rich, he may have the score engraved on copper and printed as if it were an expensive picture, or he may

have it stamped in zinc, or it may be lithographed. But if he is bent on money-making and celebrity he will go to the musical type-setter.

One of the foremost music composers in Chicago thus describes the art of translating a composer's copy for the printing press:

"When we receive the copy we read it to see how many measures it contains, how long the measures must be, and how many of them ought to be set on one staff to give the piece its best and most convenient arrangement for the performer. The 'copy-reader' counts all the notes, rests, sharps, dots, naturals, grace notes, appoggiaturas, slurs, runs and signs, and estimates just the number of 'cms' each will require. The copy is marked with corresponding directions and is given to the compositor.

"The case of the music printer is divided into 700 boxes, one of each character, and the compositor must have 'learned her case' perfectly or she will be able to make poor headway with her work. First she sets the character for the clef and the end of the staff. Then she inserts the sharps or flats of the signature, and spaces out the staff with short pieces of brass rule. Next she pieces together figures and staff rule to indicate the 'time.'

"Suppose the first note of the piece of music is a quarter-note in the second space, with a sharp before it. The compositor puts in the sharp first, and fills up the space with bits of brass rule to continue the staff; then she inserts the body of the quarter-note with two lines below, and above it she puts the two types necessary to make the stem of the note and to keep the staff unbroken. If the note is dotted, five more separate types must be inserted.

"A measure of eight consecutive notes, three-four time and a tenor clef indicated, seems to contain ten characters. As a matter of fact it contains seventy-eight at the very least, and more if the measure has accidentals, or a complicated harmony. Even the blank spaces between the notes represent five separate pieces of type, but when the music has long runs, from the top of the keyboard to the bottom, as in Paderewski's 'Minuet,' the composition is made extremely difficult, for all the added lines above and below the staff have to be embedded in a mass of 'quads' and spaces so that the notes may not be displaced in handling the form or in taking proofs.

"The more ornamental or brilliant a piece of music is, the more complicated it is to set in type, because all the slurs and marks of expression have to be fitted in between the notes just as a bricklayer fits bricks into a cornice, only the compositor cannot chop his type in two to make it fit, as a mason can divide his bricks.

"It takes four or five years for an apprentice to learn the trade through and through, and then she keeps on learning every day as long as she remains in the business. Women are successful at this trade and it offers good opportunities to them. They get just as much a page for composition as men are paid, and they make faster compositors, because their fingers are more delicate and their natures more patient.

"It is asked often whether we have to be musicians to set this type. No, not exactly, though it is essential for us to know enough of theory to avoid mistakes due to careless or indistinct copy. Composers write illegibly when they are under the influence of inspiration, just as poets do, and some-

times they put their notes where they should not be. Correcting proofs is not pleasant where the types are jumbled together as ours are, so we try to know enough music to avoid errors."

Music type is made only in Philadelphia on this side of the Atlantic, and its cost is so great that it never is put to the wear and tear of actual use in the press. As soon as the proof has been corrected by the composer the form is sent to the electrotyper, who makes a matrix in wax and returns the form to the compositor. After that comes the tedious process of distributing 5,000 types of 700 different kinds. This work is laborious because the electrotyper's wax gets into the spaces and sticks all the types together.

Although the first cost of the typographical process is several times as great as any other, it is the cheapest in the end, for when the form has been electrotyped it may be reproduced indefinitely for use on all kinds of presses and on any kind of paper. Next in importance is the lithographic process. The composer's copy is estimated, as before detailed, and then is copied in reverse on a plate of zinc. First the plate is put through a ruling engine, which engraves the five lines of the staff. Then the engraver, with separate dies and punches of steel, stamps in the plate the notes, rests and bars of the score. The plate is hammered on the reverse side until all the "burr" is removed. The plate contains all the characters, precisely the same as for the plate printing. The lines are filled with a thick transfer ink, and the plate is carefully wiped with a swab and potash. From this plate an impression is taken on paper in a regular etcher's plate press, and this transfer in turn is conveyed to the surface

of a lithographic stone. From this point the process is the same as that used for the production of posters in one color, the stones being kept wet with water and the ink adhering only to the characters of the music.

If it is desired to print only a few copies of the music, the expense of lithography is avoided by using the zinc plates direct, as in card plate work. To do this, however, it is necessary to fill the incised lines with beeswax, otherwise the impressions would take up too much of the ink and be blurred or embossed by the heavy pressure of the press.

The ink used in this sort of printing is of a special nature, prepared fresh daily from Frankfort black and light boiled oil. It is a smooth, oily substance, wholly unlike the tarry ink used on ordinary presses. The plate presses themselves are of a peculiar pattern. A heavy bed of iron supports the engraved plates with the moistened paper laid upon them. A capstan wheel with six arms moves this iron bed between two large iron cylinders moving in the same direction. A heavy blanket of felt around the upper cylinder is forced upon the paper, and the impression is imparted by the ink in the engraved lines of the plate. As these presses have to be run by hand, and as the plates have to be inked and wiped after every impression, it costs half a cent a sheet to print music in this way, but the clearness of the print exceeds that of any other process except copper engraved with the burin.

The tools used in punching the zinc plates in the process here described are of a peculiar kind. Each sort of note, rest and expression mark has its distinct tool, but the stems and hooks are not connected with the

bodies of the notes, as the engraver must be prepared to copy all kinds of curious conceits of the composer. On the face of the die used to stamp the body of a note is a slight ridge, which fits into the line of the staff on which the note is to be indicated. This device makes it possible for a skilled man to copy a manuscript with great speed and precision.

After all the body characters of the page have been punched, the plate is reversed and hammered to straighten it and the workman attaches the stems and hooks, puts in the grace notes, and cuts the slurs with a graver. If the words of a song are required, he stamps each letter separately to correspond with the note to which it is to be sung.

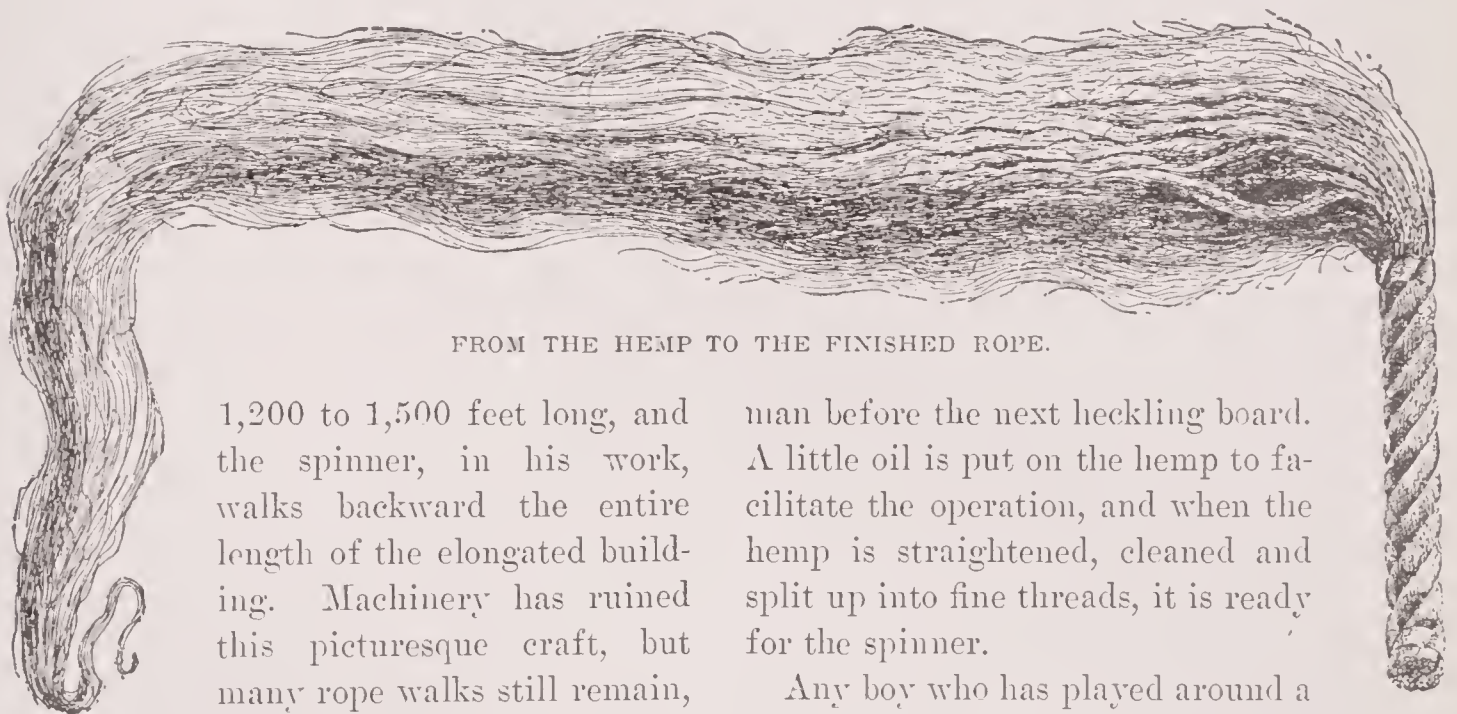
In this connection it is interesting to note the curious dread felt by some young composers lest their compositions be pirated and their fame be lost or gained by some stranger. In Chicago several engravers are kept busy with work which the authors refuse to submit to music publishing houses lest they be robbed of their glory. In some cases composers are so jealous of their laurels that they refuse to commit an entire work to any single printer or engraver, but parcel out one page to this man and another page to some one else.

Some musical copy is written with notes a quarter of an inch thick, on a staff two inches wide. A famous Chicago composer writes all his scores with a blue crayon, and so loosely that the engraver ought to make a complete study of harmony and thorough-bass before he begins to copy the notes. Other equally good writers make their notes with stub pens, and with such care that any musician could read them in concert at first sight.

ROPES AND ROPE-MAKING

Spinning yarns is a favorite time-killing recreation with sailors. It is said that this term, used to designate long-drawn-out tales of land and sea, is derived from the "yarn-spinning" process which is unique to the old-fashioned rope walk, in which all hawsers, cables and other cordage were made in the "good old times." Literally and figuratively, spinning yarn is a long-drawn-out process, for a rope walk is from

the fiber is first "heckled," to remove the tow from the "line," and also to divide the fiber into finer strips. A series of the "heckle boards" is used, graduating from coarse to fine. This board consists of a wooden plank, studded with many sharp-pointed steel prongs. The workman takes a handful or a "strick" of hemp, and draws it through the steel prongs, thus combing the fibers and straightening out the tangles. The loose stuff, dirt and tow, also come out, and then the heckled fiber is handed to the



FROM THE HEMP TO THE FINISHED ROPE.

1,200 to 1,500 feet long, and the spinner, in his work, walks backward the entire length of the elongated building. Machinery has ruined this picturesque craft, but many rope walks still remain, and some sailors prefer the hand-made to the machine-made article.

All cordage an inch and over in circumference, goes under the general name of rope. If smaller than that it is known as cord, lines, twines and yarns. Excepting for steel and iron rope, hemp is the fiber which is the staple of the ropemaker. As this fiber is seldom longer than three and a half feet, it must be twined and twisted together to unite it into one long yarn, which is the unit of a rope no matter how large and heavy it is.

To prepare hemp for the yarn-spinning,

man before the next heckling board. A little oil is put on the hemp to facilitate the operation, and when the hemp is straightened, cleaned and split up into fine threads, it is ready for the spinner.

Any boy who has played around a hay mow knows how to make a rope out of hay. He knows that by pulling a wisp of hay partly out from the mow, and twisting it, walking backward all the time, he can twist a long rope, for the twining-hay catches more hay, and thus the rope is made. Spinning hemp fiber into rope yarn is done in much the same way, except that the twisting is done by a "whirl," and the hemp is carried around the waist of the spinner, who feeds it out as he walks backward the length of the rope walk.

The "whirls," generally a dozen in number, are set in a frame in which is a large,

flat-rimmed, wooden wheel. Sometimes the wheel by direct friction spins the "whirls," which are simply steel hooks set in wooden spools, and sometimes the "whirls" are spun around by a belt which passes around the wheel and all of the spools.

The spinner, after placing a bundle of dressed hemp around his waist, with the ends in front of him, twists some of it in his fingers and fastens the twisted fibers to one of the whirl hooks. An assistant turns the wheel and the hook spins around, twisting the fibers to the right. The spinner walks slowly backward, feeding out the hemp to the yarn by drawing it from his waist with his left hand and letting it slip between the thumb and fingers of his right hand, which are protected by a piece of woolen cloth.

He takes care to supply the hemp equally to the yarn, and sees that it enters the twisted part by the ends and not in the middle. As the yarn lengthens the spinner throws it over hooks set in posts to keep it from the floor, and when he reaches the end of the rope walk a second spinner takes the yarn from the whirl, gives it to another man, who attaches it to a reel, while the second spinner begins his backward journey down the rope walk. The first spinner holds his yarn tightly so that it will not untwist, walks toward the reel as his yarn is reeled in, and when he arrives there waits for the second spinner, who attaches his yarn to the one first made, so that the yarns are joined in one continuous piece.

After "warping" or stretching the yarn to one length, it is passed through hot tar, if tarred rope is to be made. Tarred rope is not so strong as white rope, but it will last longer when exposed to water, so that almost all rope is tarred. Sometimes the

yarn is taken from one reel to another and made to pass through hot tar on the way, a roller squeezing off the surplus tar, so that just the right quantity is put on. Yarn for cables requires more tar than yarn for hawser-laid rope, and for standing rigging it is sufficient if the yarn be merely covered with tar.

The next process in ropemaking is to form the strand. A rope is made up of a certain number of strands, the strand being made from two or more yarns. When three strands are laid or twisted together they make a hawser-laid rope; three hawsers laid or twisted together produce a cable-laid rope or cable, and when four strands are laid around a core or central strand the rope is called a "shroud-laid" rope.

The yarn is twisted to the right; when yarns are made into a strand they are twisted to the left; the three strands in a hawser are twisted to the right, and the three hawsers which make the cable are twisted to the left. Thus, in each successive process the twist is reversed, and this serves to make the rope tight and hard. If the twist is too hard the rope is weakened, and the principal fault in hand-made rope is due to the fact that the inner strands are looser than the outside ones; this throws all of the work on the outside strands, for they will not stretch as much as those inside.

In forming the strand, two or more yarns are attached to a single hook which twists the yarn to the left. Then three or more yarns are attached, separately, at one end, to as many hooks as there are yarns. All of the yarns are hooped together in a single hook at the other end, and this hook is turned in an opposite direction to the turn of the other hooks, and this double twist-

ing, regulated by the ropemaker, who sees that each strand gets its proper twist, lays the rope. This twisting is done by a machine called a "former," which travels on rails down the rope walk. Cables are made from hawsers in the same way.

Machines for ropemaking are composed of revolving or twisting parts, standing parts, and reels or bobbins on which the yarn, strands and rope are wound as fast as they are made. In the simplest machine there is one fixed and one revolving section. If that part which holds the bobbins on which the yarn or strands are reeled is fixed, then the part which receives the twisted product on reels or bobbins revolves.

Some machines combine the operations of forming the strands and laying the rope. In this machine three flying or revolving bobbins form the three strands. All of this part of the machine revolves, so that the three strands are twisted into the rope, which is reeled up as fast as it is made on the revolving portion, which receives the strands and lays them into rope. This combination makes a complicated machine, with many gear wheels and bobbins and reels, and it may be vertical or horizontal. Heavy cables, however, are still laid in the old-fashioned rope walk.

The Chippewa Indians in northern Wisconsin make crude rope in a primitive manner from the inner fibers of basswood bark. They loosen the fibers by beating the bark, and after cleaning them, twist them into yarn and strands, afterward twisting the strands into rope. They do not rely on the twist to hold the fibers together, but tie knots in the rope at intervals, and it is strong enough to be used in holding their tepee poles together, and for such use as

the Indians put it to. When the Puritans landed in New England they found the Indians making cord and twine out of wild hemp, which they heckled and spun by hand. Ropemaking was one of the first industries established in America, and in the eighteenth century American-made rope was held in high esteem all over the world.



SHODDY—WHAT IT IS AND HOW MADE

Shoddy, in the popular sense, is applied to clothing of inferior quality. To the average mind the term simply means that the goods are poor, and the uninformed person has practically no idea of what shoddy really is. In reality, shoddy is a commodity which admits of a great deal of comparison, for in the business world no less than forty different grades and qualities of shoddy are marked and sold, and instead of shoddy always being an indication of poor goods it may be that the goods are all the better for it.

Shoddy is the product obtained by shredding woolen cloth into wool again. It varies as greatly in quality as do the original wools. It is used in combination with new wool in the manufacture of all sorts of woolen cloth, and if the dame who is too proud to consider for a moment a dress goods which contains shoddy, could analyze some of the combination cloths of wool and silk, and indeed most any of the woolen or semi-woolen garments she wears, she would be sure to find more or less of shoddy in them. The article is never used alone, and is chiefly used for weight.

The manufacture of shoddy commences with the collection of the rags from which

it is made. The rags sold by the prudent housewife to the itinerant vender are resold to the rag jobber. There are a number of dealers in rags in this country who do millions of dollars' worth of business every year, and the shoddy manufacturer obtains his stock from these. Before being shipped to the shoddy-mill the rags are sorted, and the woolen ones are the only ones used for the purpose in hand.

When the woolen rags come to the mill in great bundles, they are first dusted. Mixed wools from everywhere are thrown together, all colors, soft worsteds, rough jackets and all the rest. The dusting is done by a machine which very much resembles a grain duster. The rags are thrown into a large semicircular box in which revolves a large wheel fitted with wide paddles. The light dust is blown out at the top of the machine and the heavy dust falls out at the bottom. After being thoroughly dusted the goods are sorted.

Great heaps of them are thrown before girls seated at long and wide benches. Here piece by piece the rags are examined and separated into the many different grades, by fingers rendered deft by long practice. The finer grades, such as the several worsteds, the fine black tailor goods, the light flannels, stockings and the like—there are forty grades to be made out of the several kinds of cloth before the process is finished—are thrown to themselves, and the heavier grades are kept separate. The work is done rapidly, and at the rate of 35 cents a hundred pounds the girls make good wages. In England the sorters receive 8 cents a hundred pounds.

After being thus sorted out, the rags are further prepared for dismemberment by separating from them all portions of cot-

ton, even to the smallest bit of thread. The process is varied and differs in the several mills, and one of the secrets of the trade is in this portion of the work. In the old process all this work was done by hand, and in the old country mills—at least in some of them—this practice is still continued. In most American mills, however, the competition has become so strong that a shorter and cheaper process has been found necessary, and instead of the hand work the cotton is taken out by a chemical process.

The rags from the sorting room are taken to another portion of the building, and are plunged into a hot bath. The water in this bath is chemically treated, and therein lies the secret. Sulphuric acid is the chief component of the mixture, and the exact formula varies. This bath eats out all the cotton, rendering it so rotten that the woolen pieces will fall away from it when there is the least bit of force applied. Thence they are thrown into a patent drying arrangement known as a hydro-extractor.

This machine consists of a large, tub-like vessel of steel, which is perforated all over with holes of good size about two inches apart. This "basket," as it is called, is about two feet deep and is surrounded by an iron vessel constructed so as to catch all water which comes out of the perforations in the basket, the whole resembling an old-fashioned set of miller's wheels in place. The rags are thrown into this basket, and the latter is so connected that when power is applied it revolves at a rate of about 1,500 revolutions a minute. The water in the rags is thus forced out of the holes in the side of the basket by the centrifugal force, and when the rags are removed from this extractor they are about as dry as

though they had passed through an ordinary clotheswringer.

From the extractor they are placed in a drier, where steam pipes are run above them, and a current of air is forced over the pipes and through the rags, emerging at the bottom of the drier. The current is controlled by a revolving fan, and the drier generally consists of a long, box-like arrangement, the upper portion of which is filled with the steam coils, the rags being thrown on wire netting and stretched across it transversely.

When thoroughly dry the rags are run through an "extract duster." This duster is practically the same as the one used at the beginning of the process, except that the dusting is more violent. It is designed to thoroughly remove every portion of dust, cotton particles, such as portions of thread or small patches in the garment dismembered, and, in short, all substances other than the pure wool. The machine does the work very effectively. Then the pure woolen cloths are sent to the dyeroms, where they are dyed as wool from the animal would be.

Only the principal colors are used—blues, blacks, browns and the like—the several shades being obtained by the mixture of the rags in the process later, just as in the work with new wool. The mordant used in the dyeing process is the ordinary chrome mordant, made from a solution of bichromate of potash and acetic or oxalic acid, the former for the blues and the browns, the latter for most of the other shades. From the mordant bath to the dye vats is but a short distance, and after being boiled the requisite time in the color vats, the rags are again passed through the patent clotheswringer, called the hydro-extractor, and are ready for the final process, which

is, in short, the tearing of the rags into the original wool.

Before being shredded the rags are mixed so as to form the shade desired in the shoddy. They are spread out on a floor and are mixed by hand, there being no small degree of skill required to so distribute goods as to bring a new color by the combination, but when they finally are properly mixed the rags are wet down with ordinary wool oil. This oil is thoroughly shaken up and is applied to the rags by a hand sprinkler.

The rag picker comes next. It is a machine simply constructed, consisting of a cylinder revolving in a circular box. The rags are fed into it by means of fluted rollers, held in place by weights. On the cylinder are 11,000 steel pins, so arranged that as they catch the rags the latter are shredded. The threads are pulled apart, and when the threads are separated, even they, too, are separated into the woolen hairs which compose them. The rag picker also separates the good wool from the bad, throwing the latter out at the top and passing the former out at a point below the feeding place, but on the same side of the machine. It corresponds to the wool picker in the process of preparing the wool from the animal, and is preliminary to the work of the carding machines which follows.

The carding machines comb the wool particles more thoroughly, and turn out the product ready for use in the spindles at a woolen mill, in connection with the new wool used. The product, after it has passed over the revolving cylinders of the carders, fitted with the thousands of small teeth which separate, combine and recombine it time and again until it is thoroughly combed out and mixed, is of a uniform

shade and in the shape of long, fluffy rolls. It is then packed into bales under hydraulic pressure, and is shipped in this form.

As it is used, shoddy may or may not be poorer than original wool. The shoddy made from the ordinary grades of woolen rags is not so good as the new wool, for although the product to the ordinary observer resembles the new wool, the hairs are shorter, and, after having gone through the wear and tear of the life of the garment and the process of shredding, are not so strong. The shoddy made from fine woolen goods, such as worsteds or fine flannels, is in many respects better than the new wool of the ordinary grades, the hairs being longer and the texture finer.

When, therefore, the charge is made that shoddy is used in the construction of a certain cloth, it is well to specify what grade of shoddy is used, and what quality of cloth the combined product is supposed to be, for a cloth containing a good grade of shoddy may be better cloth in many ways than another cloth which consists entirely of new wool. More shoddy is manufactured in the United States than in any other country in the world. It is the industry which makes \$7 suits and \$10 overcoats possible.

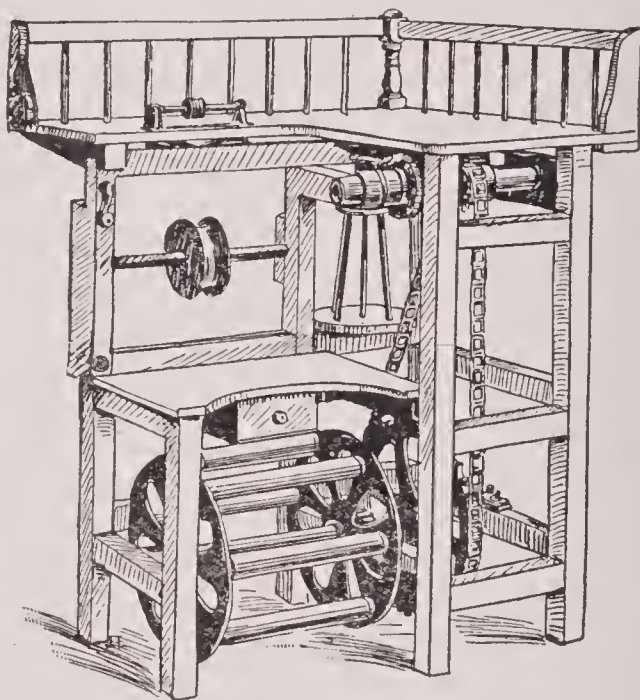


BROOM-CORN AND BROOM MAKING

Brooms for the whole world are made in America, and the greatest broom-corn fields on earth are about Arcola and Tuscola, Ill. A few brooms are made in Europe, but far the greater number are imported from this country, and most of them from a district included within a radius of 200 miles from Chicago. There are about 1,100 establishments interested

in the manufacture of brooms to a greater or less extent in this country, and there are as many more establishments engaged in the manufacture of the supplies needed in broom manufacture. It takes about 10,000 persons to keep the housewives of the civilized world supplied with brooms.

Broom-corn grows practically the same as cane. The standard variety reaches a height of about eight feet on an average. The dwarf varieties, used in the manufacture of whisk brooms and similar articles,



BROOM-MAKING MACHINE

grow to a height of four feet or thereabouts. Only the top part of the stock—the "tassel"—is used in the manufacture of brooms.

These tassels are shipped to the factory in bales containing from 200 to 300 pounds of the long straws bunched together on their stems. When about to be used, the corn is taken from the bale and immersed in water in a large tank, which generally is just outside the door of a long, low, wooden building, the typical broom factory.

After receiving a bath of water the corn is dipped in a dye bath, dark-green in color, yet not very strong. This dye brings to the corn the greenish tint characteristic of good brooms, and colors the red portions of the stock to the uniform hue; the red in the corn is considered a bad point in quality.

After its dye bath the corn is thrown into a great covered box, through the bottom of which arise the fumes of burning sulphur. This process of bleaching brings to the corn the proper yellow body color and leaves the corn in a condition to be easily cut with the knives and machines of the workmen. When first it comes from the field it is too brittle for work.

After being bleached the corn is thrown on a large table, where it is sorted. First, the stem is cut off just above where the straws commence to grow out. This allows the outside and lower straws to be stripped off, and these are the best quality of straws, and, under the name of "hurl," are used for the outside of brooms. Other straws are stripped off and, under the name of "self-working" straw, form the body of the broom.

What is left, under the name "insiding," is that straw on which the broom is built. The insiding sometimes is divided into two qualities and the self-working straw often is called the "shouldering," as it is used to give to the brooms the "shoulder" portion of their form.

When the broom straws are thus sorted they are turned over to the winder, who builds up the broom on a machine peculiarly crude for one which does such good work. The machine consists of a table-like arrangement, at the edge of which is a revolving hollow shaft into which a ready-

made broom handle can be placed and there securely clamped.

A spindle of broom wire is arranged so as to conveniently play upon the broom handle as it revolves with the hollow shaft. Power is applied by means of a "squirrel cage," so that the machine can be turned forward and controlled at will, and can be reversed.

In the lower end of every broom handle a small hole is bored, and when the workman has placed a handle in the winder the end of the wire is passed through this hole, and a few twists of the machine firmly bind it in place. Under the angle of the wire, stretched from the spindle feeder to the broom handle, the workman places a bunch of insiding or coarser straw, and gives the handle another turn by means of the squirrel-cage arrangement.

The stub ends of the straw are then trimmed off with a knife and after one or two rounds of wire have been run around the handle, bunches of the shouldering are bound down to the handle on opposite sides of the piece, and after the stub ends of this have been well trimmed, so as to give the shapeless mass something of the form it is to be later, a strap is slipped around the whole and is fastened so as to hold the flying straws in place.

The wire, too, is held in place for the time being by a strong tack driven into the handle so as to cover the wire with the head. The workman then takes two large bunches of the finer straw—the covering—and as the broom handle is revolved he dexterously spreads the covering around the whole mass. This coating of the finer straw is repeated, and the whole is again held in place by a strap. The ends of the finer straw are trimmed and the wire is

fastened by a tack, around which it is wound.

A "lock," or tin covering, of fancy shape and design, is tacked on the handle so as to cover the ends of the straws, and a string replaces the strap as the broom is unclamped from the machine to be passed to the presser and sewer.

The broom press is simply an improved form of vise, so made that a broom can be placed in it, handle downward, and considerable pressure be applied to it. Most hand presses are formed of two very strong boards securely bolted upright to a base, which permits them to move. These boards are brought together at the top to form the vise by a double lever which produces great pressure between them with a comparatively small use of hand power—two horse-power pressure being applied in most cases. Other presses consist of a similar clamp arrangement worked with a screw. These are considered easier, but less effective in operation. Into one of these presses the broom is placed and the pressure applied. The straw is forced into about the shape usually seen in brooms, and the workman then sews it.

A strong flax cord of fancy color is passed around the broom twice, and the workman then threads his needle with it and passes it through the broom at intervals of about an inch, all the way across. The needle used is large, with blunt ends, and has the eye in the middle. The sewer wears a thick leather palm for a thimble, and the sewing is done with remarkable deftness. When the sewing across the broom is completed the handle of the broom is forced further into the press, and another seam is sewed. In the best brooms four seams are taken, in the cheaper grades three and in

poor grades only two are taken. After being sewed and pressed the brooms are "scraped" or combed out by a large wooden cylinder, from which project many sharp spikes. The finishing process is the trimming of the broom off square at the end.

The machinery and processes thus described are in use in most of the factories over the country, especially where the best brooms are made. The machinery is crude but effective. Steam machinery has been introduced with but little, if any, success. A workman can press and sew ten dozen brooms a day, and a machine is claimed to have a capacity of forty dozen brooms a day with a man and a boy running it. This rate, however, is not maintained by a machine in actual work.

There are many special materials demanded in broom making. The wire, for instance, is a peculiar steel, tin-plated article, most of which is made in Massachusetts. The broom handles are generally of hard maple taken from the Michigan groves. Often they are made of ash and basswood. The tacks used are of a special make, tinned, strong and not brittle. The cord for sewing, generally of yellow or green or red, is of a wonderfully strong flax spinning.

Every season nearly six thousand acres of broomcorn are planted and grown along the line of the Illinois Central railroad in central Illinois. A number of farmers in that part of the state have made this their principal crop for many years and it has proved profitable. Consequently Illinois has the largest broomcorn field in the world.

Much corn is raised in Kentucky, Missouri, Kansas, Texas and other states, but the crops are scattered and irregular and

are not of so much profit to the producer. The corn seems to thrive best on timberland soil, and the rich, black loam of the greater portion of Illinois is too rank for it, the product from such soil being very coarse, red-topped and kinky, the latter quality being fatal to its usefulness.

The varieties considered the best are known as Missouri evergreen, Kentucky green, and shaker green. The corn is graded by its color, fiber and general condition. The corn of the best fiber is raised in Texas, where often the straws are four feet long. This sort of straw is especially valuable for covers. For ordinary work short but fine fibered corn is considered the best and this is the sort generally raised in Illinois. Broomcorn first grew in the swamp lands of South America.



WIRE AND ITS MANIFOLD USES

This has been called the "age of wire." The man who baptized the last quarter of the nineteenth century with this synonym for "fin de siècle" referred to telegraph and telephone wires, but he builded better than he knew. The many common, every-day things into which wire enters, either as an essential constructive element or an important factor, justifies any one in calling these years the "age of wire." Besides the hundreds of thousands of miles of wire which are strung on telephone, telegraph and trolley poles, the hundreds of thousands of miles used for fencing, and innumerable miles wound around field magnets and armatures of dynamos and motors, coils and transformers, and other things accessory to the electrical industry, wire is woven into hundreds of thou-

sands of square yards of netting, cloth and screens; tons of it are made into pins, needles, hairpins, and hooks and eyes; millions of pounds are cut to lengths, headed and pointed into nails of all kinds; vast quantities are curled into corkscrews; tons upon tons of it are sewed into books, pamphlets and magazines; miles upon miles of it are put into pianos and other musical instruments, and every day brings forth some new use for the valuable metallic string.

One of the most recent utilizations of wire is found in its adaptation as a strength-giving covering for steam pipes. The plan of winding steam pipes over eight inches in diameter with copper wire is pronounced by engineers to be an important innovation, since the wire doubles the bursting strength of the pipe so wound. Copper pipe is treated in this way, and another important result has been secured, for the thickness of the sheet copper composing the pipe may be reduced to the minimum without weakening it.

In practice the copper pipe is wound with steel wire, the copper of the pipe being reduced to the thinnest possible gauge. The spaces between the wire and coils are filled in with copper, deposited there by the process of electroplating, and thus increased strength all around is secured.

Perhaps the most interesting phase of this use of wire comes in winding great pieces of ordnance to increase the strength of the monstrous cannons. Wire-wound guns have reached their highest state of development in England, and many of Great Britain's new battleships are armed with them. Although the practice of winding guns with wire began but a few years ago, in England hundreds of such guns,

ranging from 12-pounders used by the horse-artillery, to the enormous 12-inch guns which stick their wicked noses through the portholes of barbettes and turrets on modern English battleships, are found in his majesty's service on land and sea.

The system of winding a large gun with wire is simple, for it is done in a lathe which is but an exaggerated form of the machine found in any shop. The wire used is steel, and is ribbon-shaped instead of round. For a 12-inch gun, which weighs 46 tons, the dimensions of the wire are 6-100ths by 25-100ths of an inch, and 102 miles of wire are wound around the barrel.

The wire is not wound around the barrel proper of the gun, but around the steel hoops which are shrunk around the tube that carries the projectile. The tube of the gun is first surrounded with layers of steel hoops, or in the case of the new 12-inch guns, with one steel hoop which grips the tube from end to end. Over these steel hoops the wire is wound in successive layers, varying in different guns from nine to seventy-eight layers in depth. The gun to be wound is "chucked" in a lathe, and the drum on which the wire is wound is placed over the gun on a shaft which automatically works with the lathe and is controlled by a brake.

The end of the wire is tucked under a ring of metal on the gun and screwed down, and then the power is put on to the lathe, which turns the gun around, winding the wire around as it revolves. The steel ribbon is wound on the barrel of the piece at an average strain of 40 tons to the square inch, and the wire, reeled off the drum, is "spooled" on the cannon until the desired number of layers are in place. Then the last end of the wire is screwed down under

a metal ring, which is turned down to the face of the wire.

When the winding is complete, steel hoops are shrunk on over the wire, so that the exterior of the gun does not show that wire is used. Thus a wire-wound 12-inch gun consists of four tubes or cylinders; first, the barrel proper, then the steel hoop shrunk over the inner tube, next the wire cylinder made of many layers of steel ribbon, and last the external steel hoop shrunk over the wire.

Guns are wound with wire to increase the transverse strength, so that danger from bursting is reduced to almost "nil," as engineers put it. It is said by naval experts that the powder is not made that can burst a wire-wound gun, for the very nature of the material and the way it is laid on regulates the tension, so that the whole of the material of the gun takes up its proper proportion of the strain when the pressure is greatest, which is at the moment of firing.

The wire is wound on under such great tension that it practically becomes part of the hoop which it envelopes. This hoop is shrunk over the tube with such extreme care that it is one with the tube, so that the entire fabric of the gun, although made up of four layers, responds at once and at the same time to any pressure, and the office of the wire is to distribute this pressure over the whole piece. The hoops, besides giving transverse strength to the tube, also give the gun "girder" or longitudinal strength, so that it is stiff and will not bend under its own weight. The wire does not give girder strength to the gun. It is there for another purpose.

It was feared at first that a shock striking the wire would break through several

layers and the wire would uncoil. But it has been found that the friction between the strands of wire is so great that, even though several layers be cut, the wire will not loosen. And then care is taken in winding the gun to tuck under the wire at intervals.

The process of winding guns with wire has lessened the time consumed in making a large piece considerably. Prior to the introduction of the wire-winding system, from fourteen to sixteen months were consumed in making a twelve-inch gun, but now it is made in less than ten months. Of this time four to five months are taken up in the preliminary work of forging, turning, annealing and testing; from six weeks to two months are used for winding, and the balance in finishing the gun.

The constructive work leading up to the wire winding consists of forging the tube from the steel ingot and rough-boring the forging. At the same time the hoops for the jacket are passing through the same process, and when the tube is annealed, hardened and annealed again the hoops are shrunk on by heating them until they expand enough to permit the workman to slip them over the tube. Then the gun is wound with the wire, the outer hoops are shrunk on, the tube is bored and rifled. The rifling is a delicate operation, requiring the best tools and most skillful workmen, for each groove must be cut separately, and there are forty-eight grooves, all of which must be exactly alike.

The hardening at the Woolwich arsenal in England is done by heating the tube and plunging it in a bath of oil. In annealing the tube it is heated to about 900 degrees Fahrenheit in a suitable furnace, and allowed to cool gradually.

Although wiring guns is a modern process, the very first cannons made were wound with rawhide and leather to increase the transverse strength, and shotgun barrels were made some years ago by winding soft iron wire on a mandrel and welding the wire in one solid piece.



FIREWORKS AND THEIR MANUFACTURE

When Thomas Jefferson wrote an account of the adoption of the Declaration of Independence, he said that in years to come patriotic Americans, no doubt, would celebrate the day by memorial exercises, speeches and songs, and by the firing of salutes with cannon and the burning of fireworks and illuminations. It is not likely that in his most prophetic moments the author of the Declaration foresaw how literally and extravagantly his suggestion would be carried out. The amount of money burned up annually in the explosion of fireworks on the Fourth of July, not to speak of the incidental conflagrations that occur in every city as a result of careless celebration, is almost incalculable. The same amount expended in another way, within the course of a century, would erect public libraries, schools, memorial buildings and monuments to celebrate the gaining of our national independence, in every town and village in the United States.

Nevertheless it is hardly to be expected that the national habit will change abruptly, or that the manufacturers of fireworks will find their business diminished as a result of a sudden increase in popular wisdom.

The American fireworks makers are far

ahead of European pyrotechnists, although the largest firm dealing in such products is an English concern. Even the Chinese have fallen behind in the manufacture of firecrackers and torpedoes. Nowadays boys care little for the small firecrackers which formerly came only from China. They want something like the cannon-

of the firecrackers are made in the east, and the largest factory is in New Jersey. In the town where this factory is located, a great deal of the work is done in the homes of the operatives, for it is all hand-work. The smallest firecrackers made there are about two and one-half inches long, and from that size they run up to



AT WORK IN A FIREWORKS FACTORY.
Showing rockets, mines, wheels and Roman candles in process of making.

cracker, loaded with dynamite, which makes a noise like a small cannon.

Americans began to make firecrackers in large quantities only a few years ago, and now they are turned out by the thousands, and no Chinese cracker can compare with those made in this country, so far as noise and explosive power are concerned. Most

those big fellows a foot long and longer. The tube of the cracker is made of straw-board; the fuse of spun cotton, soaked in a mixture of starch and fine gunpowder, and the explosive compound is a mixture of powdered charcoal, bichromate of potash and chlorate of potash. This mixture is supposed to be a secret, but it has been

used for years in making squibs, "devil-chasers" and explosive pin-wheels. The Chinese makers of firecrackers are very expert in rolling the tubes, but right here comes in the Yankee ingenuity which meets pauper-labor with labor-saving machines and devices, and beats it in productive capacity. One American girl can turn out more firecracker tubes in a day than a dozen Chinese can, and they are better tubes for the purpose, too. One girl can turn out about 2,500 tubes a day. The tubes are placed on a rack in a hot room, and dried hard for two or three days, and are then ready for the filling.

The bottom of an American-made firecracker is plugged with a piece of cork or pith, or with a pasteboard wad. The top is plugged with clay or clay-pulp, mixed with a strong adhesive, and through this clay, which is generally used, the fuse runs. The fuse is put in first, and the man who does it works the firecrackers off in bunches of one hundred. He has a board in which are placed in upright position 100 brass, wooden or iron pins. These pins are just the size and shape of the inside of a firecracker, but are about three-quarters of an inch shorter, so that when a tube is slipped down over one of the pins, the tube will stick up above it three-quarters of an inch. Each pin has a round hole running down through its center, and before the tube is placed on the pin, the fuse for the firecracker is stuck in the hole, leaving a couple of inches of it above the pin. The workman takes a pinch of prepared clay and rams it down in the tube upon the pin. This plugs that end of the tube, and fastens the fuse in the center as well.

The tubes with the clay plug and fuse are next turned over to a girl who loads the

firecracker with its explosive. She handles 100 at a time also, and the loading device is as simple as it is ingenious. It is made of two boards, in each of which are bored 100 holes. The holes are a trifle larger than the firecrackers, but those in the bottom board do not pass quite through. The firecrackers are placed fuse end down in the bottom board, and the top board, with its holes exactly over the open end of the tubes, is placed on top of the crackers.



MAKING PARACHUTES.

The girl scoops a quantity of the explosive mixture from a box, puts it on the top board, and with a brush sweeps the powder into the holes, filling the firecrackers. The top board is then taken off, and a piece of cork, or whatever material is used to plug the firecracker, is rammed down to the powder of each firecracker.

The firecrackers are then coated with red

paper, by girls who arrange a number of sheets of the thin, tough paper upon a slanting marble slab, brush paste upon the ends of the sheets, and with the palms of the hand roll the firecrackers, one at a time, over the paper, thus coating them. The firecrackers are dried for some time and then packed, and are ready for the Fourth of July.

The Chinese or the Hindus were the first makers of fireworks, and probably gunpowder or something like it was burned on festival days several thousands of years ago in China. The plains of China and India have large deposits of saltpeter, which is one of the chief ingredients of gunpowder. It is supposed that the first man who made gunpowder was an Indian or Chinese, and that the discovery was accidental. For years saltpeter was called "Chinese snow," and the records of early travelers through China show that the Chinese used their "snow" to make "earth thunder" and "devouring fire." The accidental discovery that a mixture of charred wood and saltpeter would make a flashing material, easily led to mixing sulphur with it, and gunpowder was the result.

Now nitrate of potash and chlorate of potash are two of the most important constituents of fireworks. They supply the oxygen which is required in an explosive, for an explosive is nothing but quick combustion, and combustion cannot take place without oxygen. Heat of course must be applied to start the oxygen, and this is done either by percussion, as in a cartridge, or by a burning fuse, as in a skyrocket.

In fireworks the colored effects are given by the burning of sulphur, sulphides of arsenic, iron and steel filings, and other metals, such as sodium, which gives a yel-

low fire, calcium red, strontium crimson, barium green, and copper green and blue, when reduced to powder and mixed with the oxidizing agents.

But whatever the mixture is, it must have something to supply the oxygen, and it is said the Chinese found that out nearly 2,000 years before Columbus discovered America. Now they make their gunpowder according to the white man's method, buy immense quantities of roman candles, sky-rockets and pin-wheels of English and American manufacturers, and in a few years may have to come to America for their firecrackers.



MATCH MAKING IN VARIOUS COUNTRIES

One of the evils which the working people of France are trying to remove from the industrial body is the use of white phosphorus in the manufacture of matches. The poisonous fumes rising from the pans in which the material is heated, and the constant handling of the stuff, give the workmen in match factories the horrible phosphorus necrosis, a disease which attacks the bones, disintegrating the tissues and causing untold suffering. The French government, which has a monopoly of the manufacture, has endeavored to compel matchmakers to daily, before leaving the works, gargle their throats with chlorate of potash, a counter-poison to phosphorus, but the working people do not observe the rule, and in turn ask the government to use amorphous phosphorus and salts of potassa instead of white phosphorus. The latter material is the cheapest, however, and the slow poisoning of French matchmakers still goes on.

The French method of making matches differs in some particulars from that employed in Sweden and this country. The French match is made of splints produced from fir and poplar wood, except when the splints come from Russia, where vast quantities are made from the aspen tree.

The splints are made by machines, which turn out about 300,000 an hour each, and one of the great government works in France uses up over 24,000,000 of these splints in a day. They arrive at the factory in large cases, and are sent through the works in batches of 7,000 or 8,000 at a time, each batch being arranged in a square frame called a "batteau."

A splint-laden batteau is placed in a machine, which automatically separates the splints, so that each of the 7,000 has a little space around it, and is thus isolated from its neighbors. When the splints are arranged in this manner the form in which they are held is called a "press," and it is capped on one side, leaving the other with the splint heads exposed. The presses are carried to the dipping-room, which is filled with the poisonous vapors of phosphorus and sulphur. The men who labor in this place are so accustomed to the irritating,

tissue-eating vapors that they work as unconcerned as if the air were pure and wholesome.

The visitor, however, is seldom able to remain in the room more than a minute or two at a time, for the fumes cause uncontrollable coughing, and chok-



PUTTING THE CHARGES INTO ROMAN CANDLES.

ing and gasping add to the discomfort.

In one corner of the room stands a vat in which melted sulphur is held. The workman, taking the press in both hands, dips the splints in the compound two or three times, withdrawing the press with a jerky motion which shakes off the surplus sulphur. The splints are prepared for the

sulphur bath by being heated. The phosphorus compound is made into a paste and spread evenly over iron plates, which have the same area as the presses. After the splints have been dipped in the sulphur, the press is laid, open side down, upon the paste-covered iron plates, and the splints are gently forced into the sticky mixture.

When withdrawn from the paste each splint has a little knob of phosphorus on it, and has become a match. A drying operation, which gives the phosphorus tips a glossy consistency, follows, and then the presses are taken to a machine which takes the matches from the press and places them uniformly, and with heads all pointing in the same direction, in another form. From this form the matches are placed in boxes, either by machinery or by the skillful fingers of girl operatives. The form is laid in the machine and is covered with glass, so that the girl can watch the descent of the matches, which fall down of their own weight.

At the bottom of the form is an opening, just the size of the inside of the box. Back of and opposite to this opening is a plunger of the same size, which shoves forward and through the opening just enough matches to fill the box which is held to the opening. Three girls work at each box-filling machine; one fills the boxes, the other two close them. They fill on an average of 20,000 boxes in eleven hours, and each makes about 70 cents a day. In filling boxes by hand the girls become so expert that they can take up the exact number of matches required each time.

With the exception that neither sulphur nor phosphorus is used for tipping matches, the process in Sweden is about the same as it is in France. The Swedish matches are

"safety" matches that can only be lighted when scratched on a prepared surface, and the tipping compound is a paste of chlorate of potash. The igniting surface, which is placed on both sides of the match box, is a paste, of which sulphide of antimony and red phosphorus are the principal ingredients. This paste is laid on the sides of the boxes by a machine, which passes the boxes between two rollers that are charged with paste. As the procession of boxes moves between the rollers they spread the paste evenly on the sides, and then the boxes are laid away until the paste is dry.

A long, cool, dry room is required in the manufacture of wax matches. The splints are made of cotton thread, covered with stearine or paraffin. The wax match is a miniature candle, and its little wick is made of from ten to twenty threads, depending on the thickness of the match. This cotton wick is wound in large balls, held on reels at one end of a long room.

The paraffin is melted in a long bath and portions of it are dipped out and placed in small pans, through which the thread is conducted. The wax-coated thread passes from the first pan of paraffin through a steel die, which scrapes off the excess of wax and prepares it for the second coat. From this pan the twice-coated thread passes through a steel die, in which the hole is slightly larger than the first, and the third and last pan has a die which gives the waxed thread the proper diameter. Then the paraffin-covered wick is taken to a large drum at the far end of the room, on which it is slowly wound.

As the wick hangs in the air in going from the last pan to the winding drum, the paraffin cools and is quite solid when it reaches the drum. If the wick is not coated

sufficiently the drum is taken to the end of the room in which the reels stand, and another coating of wax is put on. The wick is cut to match lengths in a cutting machine, and then the wax splints are dipped in the lighting compound.

Matches that will burn in spite of rain and wind are called "fusees." The splints are dyed blue by boiling them for several minutes in a composition, and then they are dipped. The burning composition is a mixture of potash and ground sawdust, and this thick paste is put on the splints in three dipping operations, which give the match head a pear shape. The igniting compound can only be fired by rubbing it on a prepared surface, similar to that used for safety matches.

In fact, the fusee is but a safety match, with a knob of ground sawdust and potash. The inflammable tip ignites this composition, which sizzles and sparkles for a number of seconds, no matter how much it is exposed to the wind. These matches are packed in boxes by hand, for the shape of the head makes it difficult for machinery to do this work. All of the wooden splints of safety and inextinguishable matches are paraffined, so that the wood is rendered more inflammable.

The French government pensions its matchmakers after thirty years of service. The pensions for men average about \$120 a year and for women \$80. And it also pays the surgeons who operate upon victims of necrosis, caused by the white phosphorus used.



veneers for fine furniture

It would surprise the average man to know how little of the genuine there is in modern furniture. Not all is mahogany

that is sold as such, and the "solid" oak frequently is two-thirds basswood. Since the days of Pliny veneers have been used to give a handsome and costly exterior to cheap insides, and to-day veneers are used more generally than ever before, and their use is steadily increasing. Manufacturers say that because a piece of furniture is veneered is nothing against it; that as a matter of fact veneered goods have an advantage over the solid. They neither warp nor check, and the matter of cost is an important factor to the man of small means and large desires in the furniture way.

A bedroom set of solid mahogany would cost a small fortune, and with all of its cost it would not be as handsome to look upon as one in which veneers are used. Veneer cutting has been reduced to a science, and by modern methods effects in grain and figure are secured which the ancients never dreamed of, and which cannot be produced by the most ingenious straight sawing.

Properly speaking, a veneer is a thin sheet of wood to lay upon a cheaper material to give it the appearance of the more costly. Wood is cut thin to be used in the manufacture of berry boxes, baskets, casks and other commodities, but the veneer cutter does not regard the producer of berry boxes as belonging to his class, any more than the cabinetmaker looks upon the carpenter as one of his craft simply because they use certain tools in common.

New York is the great veneer-producing center of the country, and then come in the order of importance Boston, Grand Rapids, Cincinnati and Chicago, with a few scattering producers at other points. Mahogany, the king, queen and whole royal family of the cabinet woods, leads the list of material most used for veneers. Other for-

eign woods, imported in the log and cut in this country, are white mahogany, satinwood, rosewood, cocobola, amaranth, tulip wood, sandal wood, olive wood, holly, boxwood, ebony and vermilion wood. Some oak, walnut and ash are imported, because the grain and color of the foreign woods differ from the native growth.

Of native woods bird's-eye and curly maple, figured birch, figured and plain walnut, walnut burl, sycamore and cherry comprise the list generally used for veneers. Ebony is bought by the pound or ton, as are some of the other rare foreign woods, but mahogany is measured by the cubic foot. The native woods are bought by the log, in log measure, and some particularly fine specimens bring prices that seem fabulous. A single walnut tree has commanded a price as high as \$5,000, and manufacturers' agents have traveled hundreds of miles following the trail of a rumor that a fine figured walnut could be secured.

In veneer cutting three methods are used—sawing, rolling, slicing and what may be called the "reverse roll." Up to the beginning of the last quarter of this century all veneers were made by sawing, and this method still is followed exclusively in ebony, rose, olive, quarter-sawed oak and quarter-sawed sycamore, and it often is used with other woods. An extremely thin circular saw is used, and it will slice off the wood as thin as cardboard, requiring sixteen and even more thicknesses to make an inch. When the saw is used the log is run through without previous treatment, except to remove the dirt and grit which might injure the saw.

In the slicing process the log first is thoroughly boiled in huge vats, which are tightly covered, the water kept hot by means of

steam pipes. When cooked through, the log is hoisted out in a cloud of steam and is quickly rolled into the lathe. The lathe is just like an ordinary wood-turning machine, only it is built on a much larger scale, and is big enough to take a log ten, twelve and even sixteen feet long.

Pulleys and chains, so adjusted that one man can handle the largest log, are brought into play, and the log is hoisted into place and clamped fast to the revolving centers. The log is rapidly revolved, and as it turns around in the lathe a long, razor-edged knife is fed into it, a quarter, an eighth, a sixteenth or a thirty-second part of an inch at a time, according to the thickness required in the veneer.

At first a thin slice is taken off of any protuberance on the log. The next time the log makes a complete revolution the slice is larger, and gradually the log is reduced to a perfect cylinder, and the veneer is peeled off just as paper comes from a roll, the full width of the log and of any desired length. When the log has been reduced to a diameter of six or eight inches the lathe stops automatically, and the core is removed, thrown on the dump and sold as firewood.

The "reverse roll" is used in cutting veneers from mahogany, figured walnut and other kinds of fine wood. Before boiling the bark is removed from the log and it is cut in halves. Instead of being put in the lathe, the half-log is securely bolted to a heavy central bar, with the bark side in the middle and the heart of the log outward.

The central bar revolves, carrying the half log with it. The knife is adjusted as it is for the continuous roll, and at first takes off a strip only an inch or two wide, for it begins cutting on the edge of the log. The

strips rapidly widen as the cutting progresses, until they are the width of the semi-circle described, with the outside as a center. In the same way the width decreases until it is but five or six inches, and nothing but the core is left.

It is in this manner that the beautiful tree and fountain effects are obtained in mahogany and walnut, effects that can never be obtained by sawing or round cutting. The greatest care, experience and closest attention are necessary to get out of a log what there is in it of beauty and value.

The veneer cut from a log by the reverse roll process is kept by itself through all subsequent operations, as the veneers are similar in color and approximately so in figure, so that matching to get the required width is easy. The ordinary roll veneers are run from the machine to a saw, which cuts them to dimensions required for panels and other uses.

From the saw or from the cutter the veneers are sent to the dry kiln to be thoroughly and carefully cured. Veneer is sold by the square foot and goes into many channels of trade. It is used by piano makers and car builders, and enormous quantities are consumed by furniture manufacturers. Much of it is used in interior finishing of houses. Usually the veneers are put on the pianos, cars, furniture, etc., by the manufacturers who buy them, but often, and especially for panels for desks and table tops, all of the work excepting adjusting, finishing and polishing is done at the veneer factory.

The usual base for veneers is basswood. This is cut on the roll cutter to a thickness which varies with the requirements, from an eighth to three-eighths of an inch. The

foundation for the costly coating is built up, usually three-ply. The center is three-eighths of an inch in thickness and is cut to the desired dimensions for the panel.

It is run through a machine which resembles in looks a laundryman's mangle, where it is covered on both sides with glue. As the pieces come from the machine they are laid in a pile, with the eighth-inch pieces above and below, laid with the grain at right angles to the grain of the center piece. When the pile is high enough it is trucked away to the press, where, under heavy pressure, it remains until thoroughly dry.

The veneer is usually applied in the same way, the base having been run through the gluing machine, but greater care is observed in adjusting the surface pieces and handling it. The figured veneers are always matched by expert workmen and the pieces that go together to produce the best effects are fastened together with strips of paper, and then, for convenience in handling, are folded.

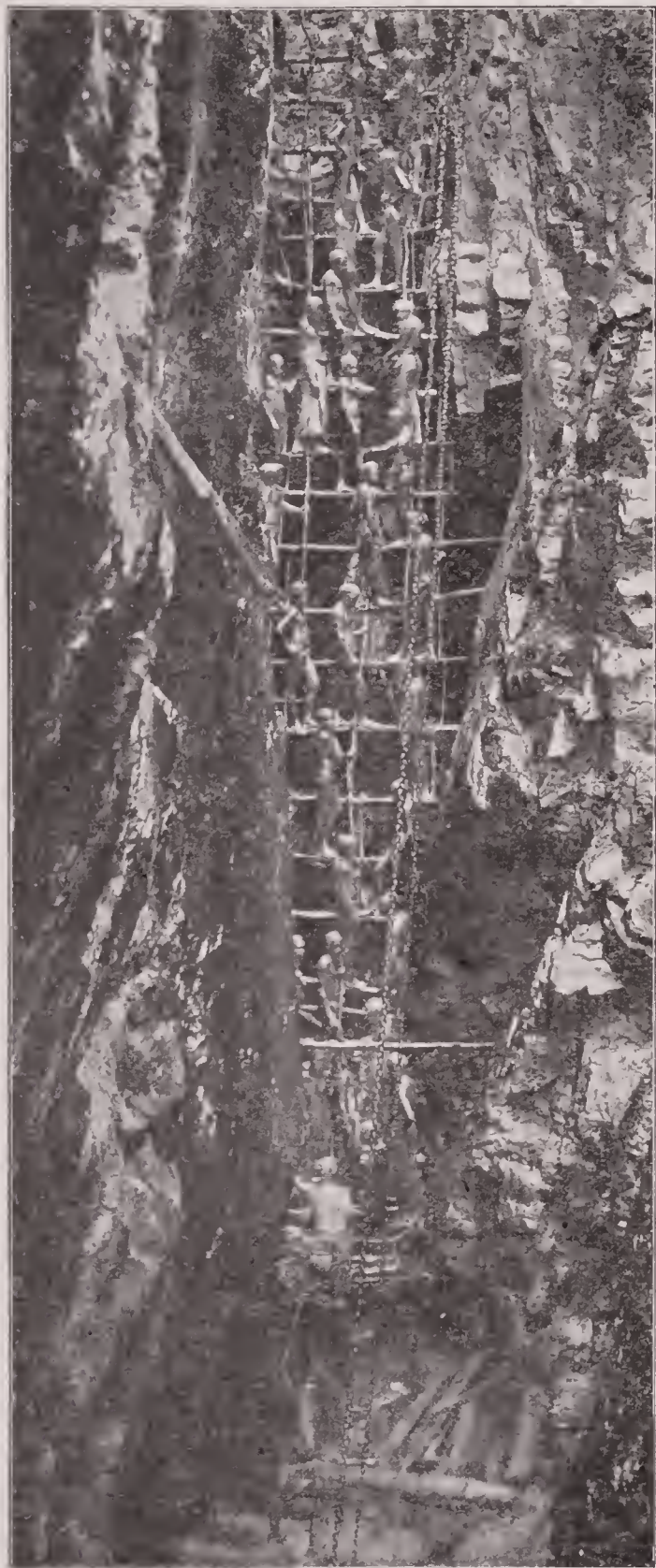
For rough work—baskets, berry boxes, drawer bottoms, backings and similar stuff—the ordinary lathe is used to cut the veneers, and the thickness varies from an eighth to three-eighths of an inch. The woods most cut for such purposes are basswood, maple, elm, birch, poplar and white wood. The largest producing section of country in the world for this product is northern Michigan, where hardwood is abundant and cheap.



GRAPHITE AND LEAD PENCILS

The "leads" of lead pencils are made of a mixture of German pipe clay and black lead, which is not lead but graphite. But

the first pencils were made of real lead, and the name has clung to them ever since.



IN A CEYLON GRAPHITE MINE.

Graphite or plumbago is a nearly pure form of carbon. In this respect it is a

brother of the diamond and a half-brother of coal, lampblack and several other dissimilar substances. But unlike coal and other forms of carbon, graphite will not burn. It is so refractory that it withstands the most intense heat that a furnace can give. Diamond, a pure carbon, is the hardest known substance. Graphite, a pure carbon, is one of the softest, if not the softest, of minerals dug from the earth. Yet a diamond can be reduced by intense heat to a cinder, while the block of graphite on which the diamond rests will not have its sharpest edge dulled by the fire.

Graphite is found in its natural state singularly pure. That taken from the Ticonderoga mines, the most important in the United States, has been found 99.9 per cent pure. It is found in irregular sheets or detached masses, with every evidence that it is the result of destructive distillation of vegetable or animal tissue. It is supposed that graphite, like coal, originally was vegetable matter, which was transformed to its present form by immense pressure and intense heat. But why it should withstand heat, and why coal which came from the same source and through the same processes, should burn, is a matter that science has not settled to the satisfaction of investigators.

Ceylon furnishes a large part of the world's supply of graphite. Most of the graphite from Ceylon is taken to England for distribution and manufacture. In this country it is found in many places, and in New York, California, Massachusetts, Vermont and New Hampshire it is mined commercially.

The graphite is taken in the lump from the mines and carried to the reducing mill, where it is ground or pulverized in stamp

mills under water. The fine particles of the graphite flow away with the water through a number of tanks, collecting at the bottom of these reservoirs. It is packed in barrels and sent to the factory, where tens of thousands of lead pencils are turned out every day.

The pulverized graphite is so fine that it

powder for the finest pencils settling in the last tank. In another series of tanks the German pipe clay which is mixed with graphite to secure the different grades of pencils, from very soft to extra hard, is graded in the same way by floating. The finest clay is mixed with the finest graphite, and the hardness of the pencil is secured by



SORTING AND SIFTING GRAPHITE IN CEYLON.

really is a dust, dingy in color and smooth and oily to the touch. It is divided into various grades of fineness, by floating on the water from one tank to another. The coarse dust sinks to the bottom of the first tank, the next finer to the bottom of the second, and so on down the line, the finest

increasing the proportion of clay in the mixture. For the medium grades, seven parts by weight of clay are mixed with ten parts of graphite.

After the graphite and clay are ground together in water the mixture is put in canvas bags, and the water is squeezed out

under the hydraulic press, leaving a mass like putty. This plastic material is placed in the forming press, which is a small iron cylinder, in which a solid plunger or piston works up and down. A steel blade having a hole the size and shape of the lead in the pencil, is put under the open end of the cylinder, and a plunger, pressing down, forces the graphite through the hole, making a continuous thread or wire of it. As long as this thread is moist it is pliable, but it becomes brittle when dry, so it is handled rapidly. It is cut into three-lead lengths, straightened out, and then hardened in a crucible over a coal fire. The leads when taken from the crucible are ready for the wood.

Pine is used for the cheap pencils, an ordinary quality of red cedar is used for the medium-priced pencils, but nothing but the best Florida Key cedar is put into the best pencils. The saw mills in Florida cut the cedar into blocks about seven inches long, and these are sawed into strips wide enough for six pencils. But as pencils are made in halves, each strip is only thick enough for half a pencil. When the strips are received at the factory, they are run through a machine which cuts in each one six grooves, round or square, and at the same time smooths the face of the wood. Both strips are grooved alike, for, unlike the European-made pencils, those made in America have the lead equally in each strip.

The filling of the strips is done by girls. The first one takes a grooved slip of wood in her left hand, and a bunch of leads in the right. She spreads the leads out in a fan shape, and with one motion fills the six grooves with leads. Next to her sits another girl who takes the filled strip, and

quickly and neatly lays on it another grooved strip, which has just been coated with hot glue by a third girl. The filled and glued strips are piled up together and put into a press, where they are left to dry. The ends of the strips are evened off under a sandpaper wheel, and then the strips are fed into a machine which cuts out the individual pencils, shapes them and delivers them, smooth and ready for the color and polish, in six streams. The coloring is done in liquid dyes, after which the pencils are sent through the varnishing machine. Then follow the stamping and finishing, all done by automatic machines, and finally the finished pencils are packed around the oval grooved blocks, tied and wrapped ready for shipment.

The pencils are counted at various stages of the making, and the counting is done in a way as simple as it is accurate. The counting board is a board on which two strips of wood are fastened the length of the board, about four inches apart. In each strip are 144 grooves. The workman grasps a handful of pencils and rubs them over the board once or twice, leaving a pencil in each groove. In this way he counts a gross of pencils in a few seconds, and does it without a mistake, for only 144 pencils can be placed on the board at one time, and if any grooves are empty the workman notices the mistake at once.

Graphite is also used in large quantities as a lubricant for the chains of bicycles, and another important use is in coating molds in electrotyping. Crucibles for chemical and other purposes, where intense heat is required, are made of graphite mixed with fire clay and a little charcoal, and then molded while moist, as pottery is made.

HOW RUBBER GOODS ARE MADE

When a man throws his worn-out overshoes into the alley he has an idea that their days of usefulness are over. But there is where he is mistaken. The rag-pickers and rubbish-gatherers rescue the overshoes out of the garbage box and sell them to the man who makes more money buying waste material than some do in corner lots or deals on the board of trade. This man sends the old, worn-out footgear which has india rubber in it to the india rubber factory, and there the old shoes are worked up into garden hose, wagon springs, door mats, belting and a hundred other things turned out of india rubber.

Pure rubber has its limitations in the industrial arts; it is too soft, too stretchy and has not enough "body" and general toughness to withstand the wear and tear to which overshoes, doormats and garden hose are subjected. Then again the rubber is too costly to be put in its pure shape into many of the everyday articles which are classed as india rubber goods, so the manufacturer mixes in rubber which has seen service with the pure Para gum, and makes it into the thousand and one things which are regarded as indispensable by machinists, electricians, workmen in all trades, and, in short, every person in the civilized world. By mixing old rubber, mineral earths and other substances with the pure gum the manufacturer is able to produce an article which he can sell at 17 cents a pound or less, when the pure gum is selling for 65 cents a pound or more.

The best india rubber comes from Brazil, and the best of that from the upper Amazon river, and this is the "fine Para" of commerce. It is sent to the factories in the

United States in the shape of irregular lumps known as "bisquits," and these bisquits are made by the "seringueiros," the rubber-gatherers of Brazil.

The seringueiro starts out with his little tomahawk about eight o'clock in the morning, for if he plunged at an earlier hour into the rank undergrowth of the forest in which the rubber tree grows, the heavy dew would soak him through in a few minutes. With his tomahawk in hand he goes from one rubber tree to another, cutting little gashes in the bark, and fastening under the cuts small tin or clay cups, not much larger than teacups. He "blazes" the tree until noon, when he retraces his steps and finds that the cups are filled with the milk-white sap which has dripped from the wounds he made in the bark.

The sap is poured into a basin-like vessel and taken to the hut where the gum is to be cured. This is done by smoking the gum over a queer furnace shaped like an inverted vase, under which are burned the nuts of the urucary, a species of palm. The nuts make a dense smoke, which pours out of the neck of the furnace. The workman, squatting beside the fire, dips into the rubber sap a wooden paddle, to which clings a thin layer of the sticky juice. Then the gum-smeared paddle is held and turned in the smoke until the water in the sap evaporates, when the paddle is dipped into the sap again. This operation is repeated until the gum forms a large lump on the paddle about the size of a man's head. This is cut from the wood, and after the "bisquit," as the ball of gum is called, has been exposed to the sun for a time, to complete the drying, it is piled up with the other bisquits and shipped away.

The india rubber manufacturer first



ROW OF OLD INDIA RUBBER TREES, SHOWING CHARACTERISTIC TRUNKS AND FOLIAGE.

Rubber trees require a long time to reach this size, but the profits on cultivation are large, and plantations have been started in late years in many tropical countries

cleans the rubber, for bits of leaves, pieces of bark, earth, stones and other foreign substances are mixed with it in the bisquit, so the bisquit is put in the "washing machine." This is composed of a pair of toothed rollers, over which a perforated water-pipe hangs. The crude rubber is cut, squeezed and mashed between the rollers, and a spray of water carries off the impurities. The rubber comes from the washing machine in irregular strips, rough as bark and resembling somewhat the old slabs of lumber which are piled up outside a saw-mill. The "mixing" machine, to which the rubber is taken next, is not unlike the washing machine, for it has a pair of steel rollers, and over them is a box or hopper filled with the compound which the rubber-maker mixes with the pure rubber. It is at this stage of the manufacture that the old overshoes, arctics, garden hose and other worn-out goods begin life again.

In the compound also is the sulphur, in one form or another, which "vulcanizes" the rubber, and which gives to manufactured rubber those preservative qualities the absence of which prevented rubber from entering into the industrial arts until it was discovered that sulphur was the substance the chemists had long been looking for. The washed rubber mechanically combines with the composition in the mixing machine, and it is then either taken to the rolls, where the rubber is coated on canvas, or else to a machine which kneads the rubber preparatory to pressing it into molds. At no stage of the process is the rubber ever melted. It is warmed up at times, but molded solid rubber goods are pressed into molds, not poured in.

A large proportion of rubber goods ought to be called rubber-clad goods, for they are

made from duck or canvas of different weights, coated with rubber, and this is done in the frictioning machine, which consists of iron and steel rolls placed one over the other, in which the duck and rubber are pressed together. As the duck passes between the rollers, the sheet of rubber laid on top is pressed into the duck, and the pressure is so great that the duck and rubber become almost one material. This rubber-clad duck is the basic fabric from which garden, fire-engine, steam and other hose, belting, packing, gaskets and other rubber goods of like character are made. Hose is made in fifty-foot lengths, from two to ten ply, and it is all made on iron mandrels, or rods, which are of the same size as the inside diameter of the hose.

A strip of pure rubber fifty feet long and just wide enough to double around the mandrel is first wrapped around the iron rod, and as the fresh-cut edges are touched with naphtha, the rubber unites and forms a pure rubber pipe, which is afterwards the inside of the hose. The rubber-coated duck is next wrapped around the pure rubber pipe, which is still on the mandrel; if the duck is wrapped around twice the hose is two-ply, if four times the hose is four-ply. The duck is wrapped around the mandrel by machinery, and small rollers press the edge of the duck, so that every inch is subject to pressure. Then another strip of pure rubber is put around the duck for the outside, and the hose, still on the mandrel, is put in the "heater." This is nothing more nor less than a gigantic boiler, fifty-five feet long or longer. Steam under pressure is admitted to the heater, and the sulphur in the compound becomes chemically united with the rubber and the rubber is "vulcanized." The hose is kept in the heater from

one-half to three-quarters of an hour, and then it is taken from the mandrel. Its ragged ends are neatly cut, and it is ready to receive the brass fittings. In stripping the hose from the mandrel compressed air is used. The air is admitted between the hose and the mandrel, and the hose, expanded by the air, slips off easily.

Rubber belting for machine shops and factories is made from the rubber-coated duck, and it, too, is made up into two-ply, three-ply, and up to ten-ply, depending on the number of times the long strip of duck is folded upon itself. When it is folded up, however, it is not cured in the heater, but in a long hydraulic press which squeezes the folds of the rubber-coated duck until the several layers of canvas and rubber are practically one solid piece. At the same time steam is introduced to complete the vulcanizing process, and make the adhesion better and the union stronger. The belting is pressed in sections, as the press is not long enough to take in an entire length of belting, and each section is under pressure from twenty minutes to half an hour.

Rubber bands sold by stationers and used by millions in offices and stores are cut from a pure rubber hose which is placed on a mandrel in a lathe. As it revolves a knife cuts off the sections of the hose, and these narrow sections are the rubber bands.

The large perforated rubber mats which cover the floors of halls and rotundas in business blocks are cut out by hand. The thick rubber sheet is laid on a block and with different-shaped dies the pattern is punched out. In this way it is easy for the manufacturer to make rubber mats to order and from special designs, with the name of the company or firm in the center of the mats.

BARRELS AND KEGS

When Pliny, who was born 23 A. D., took his first trip into the Alps, he was surprised to find the natives using casks and barrels. The discovery made such a deep impression on him that he made a note of his find, and, when he returned to Rome put the discovery into words which have descended to this age. The Romans, learning of the novel vessels used to store wine and liquids, went into the mountains and soon mastered the cooper's art as it existed in those days. They improved on the rough casks made by the mountaineers, and before many years were turning out a better product. Pliny did not fully describe those first barrels, or if he did the description was lost, for history has not disclosed what early barrels and casks were like. It is supposed that they were rough, crude, bungling affairs, with leather thongs for hoops and rough hewn logs for staves. After Pliny's time tight casks came into general use among the Romans, who spread them through the known world.

Flour, apple and other barrels made to contain solids are of more recent date. But a short time ago, flour was sent abroad in white sacks, which were inclosed in heavier ones. It rarely happens now that flour is exported in sacks, for barrels have taken their place because modern methods of production have reduced the cost of flour barrels until it is cheaper to use them instead of sacks, and barrels are much safer in every way.

The manufacture of flour barrels has grown to be an industry by itself. It is difficult to estimate how many are made each year in the entire country, but it is a great many millions. Minneapolis annually

turns out between 2,500,000 and 2,750,000 flour barrels, with Kansas City, West Superior, Chicago, Milwaukee, Buffalo, and many other cities important contributors to the total annual output.

According to the most modern and approved method, it requires eight men to turn out a complete barrel. The work is done by the piece and each man performs his allotted share and passes it on to the next. The cooper has not been entirely discarded, for he does a small proportion of the labor, such as hooping the barrel and finishing it ready for the miller. Machinery does the rest.

Staves are of elm, taken from the hardwood forests of Minnesota, Wisconsin and Michigan. The stave factory is located in the heart of the woods, for the sake of convenience and also as a matter of economy. When it is received at the city cooper shop, the stave is a flat board three-eighths of an inch in thickness, narrowing toward each end, so that it will draw into the shape of a barrel when set up. It was formerly the custom to use hickory hoops. Then those made of wire were tried; but each in turn has had to give way, and now a hoop made of elm is in general use throughout the country. The latter has been found more durable, stronger and cheaper.

The "setting up" apparatus is extremely simple. Near the workman is a large pile

of the staves corded into bundles. It requires seventeen staves for each barrel, and they are inserted in a circle between an iron "truss hoop" and the "form." Another truss hoop is drawn on, usually a wooden one, and the next workman takes the barrel. The upper ends are sticking out in every direction, and it is his business to bend them into shape. He is the "windlasser." A wire rope, working on opposing eccentrics, alternately tightens and loosens, the



MAKING FLOUR BARRELS.

motion being continuous. The skilled workman places the irregular end of the barrel into the loose loop, and when the coil tightens the staves are brought into place. A couple of wooden truss-hoops are slipped over the center, and an iron one is placed on the drawn end. The barrel is rapidly beginning to assume shape, but, as yet, there are no heads or chimes or permanent hoops.

The next step is to the heater. A small

sheet-iron stove, just large enough to fit the interior of the barrel, has been made red hot by a rapidly blazing pine fire. The barrel is placed over this and allowed to remain until the staves are thoroughly dry, and they fit as closely as it is possible to bring them together. The heat also gives the flare or bulge to the center of the barrel.

The "tapper" takes the barrel, and with his cooper's adze taps the staves from the inside until they present a smooth appearance and none of them bulge at the joints. He generally places one or two extra truss-hoops on the barrel before commencing his work. The two following steps are purely mechanical ones. The barrel goes into the "trusser," a machine which presses it together, driving down the truss hoops to keep it in place. Then it goes to the "working-off" machine, where the "croze" and the "chime" are worked on it. A workman then dexterously knocks off the two iron truss-hoops and it is ready for the cooper, who adds the finishing touches.

The cooper is equipped with an adze, a sharp spoke-shave, a hoop vise, a wooden driver, and one or two other tools of minor importance. When the barrel reaches him the staves are held in place by three wooden truss-hoops but it contains no heads. In the technical language of the shop there are no bottoms; everything is head.

The heading is put in place, then the cooper measures the hoop on the barrel, putting it in a vise and nailing the ends together with a copper staple, adding three small nails. The hoops are then "driven" into place, there being eight to a barrel. If the working-off machine has not done its work completely, the cooper supplements its efforts by running over the

side with a sharp spoke-shave. The barrel is then ready for the mill, and in a few hours it is filled with flour, ready for shipment.

When a cooper shop is run with any degree of system the output for the day represents a good many barrels. Eighty men, sixty of whom are coopers, the other twenty operating the mechanical department, can produce 4,000 barrels during a run of ten hours. If each individual were required to make a complete barrel without the aid of machinery the output for the same number of workmen would be reduced to less than a thousand.

A cooper receives from \$2.50 to \$3.50 a day at piece work, while employes in the mechanical department are paid from \$1.50 to \$4 a day, according to their duties. It is quite universally conceded among coopers that the machinery of to-day is doing the maximum of work compatible with a finished and substantial product.

Paper barrels and barrels made of broad sheets or thick veneers of wood, compete with barrels made of wooden staves for storing and transporting dry stuff. The paper barrel is made from a single sheet of straw-board, curved to a cylindrical shape and held together with metal fasteners, or it is made without a joint by a machine which by centrifugal motion throws the soft paper stuff against a mold. A steel barrel for holding oil has been put on the market, and barrels made from wood pulp chemically treated have been made.

The importance of the cooperage trade is demonstrated by the number of kegs used for the single purpose of holding beer. In one brewery in Milwaukee more than 12,000 kegs pass through the establishment each day, and that brewery turns out more

than 1,000,000 barrels of beer annually. Add to the brewing industry flour mills, nail mills, distilleries, pork packers, sugar refineries, fruit growers, paint mills, varnish works, salt works, lime and cement works and a thousand and one other industries that use barrels, casks, kegs and hogsheads by the hundreds of thousands, and some idea of the vast number of hooped vessels turned out by the cooper each year can be arrived at.



SEEDS AND HOW TO TEST THEM

When spring begins to draw near, heralded by alluring and highly colored advertisements of seed dealers and florists, the farmer, housewife and amateur gardener flood the mails with the seed orders they are sending to the dealers. The little paper packages, full of promises of lovely blooms and plump vegetables, are sent by return mail, and then come the planting, waiting, anxiety and triumph or disappointment. Those who buy their seeds of reputable, conscientious dealers have themselves to blame if plants, grasses, flowers and shrubs fail to spring from the seed; but too often the little bags or packages of seeds contain sand, crushed quartz, "dead" seed, or inferior seed mixed with a small proportion of the genuine, for seed adulteration has been reduced to a science.

Sometimes this adulteration is due to sheer carelessness on the part of growers and dealers, but more often it is the result of careful study and skillful manipulation by dishonest men. Europe set the example of mixing inferior, dead and cheap seed with the good, to increase the profits of the grower and dealer, and some of the worst pests which trouble farmers were intro-

duced into this country through the medium of adulterated seeds. The Russian thistle, a foul weed which covers over 35,000 square miles of good farming lands and seriously interferes with agricultural operations in seven states, stole into the United States more than a score of years ago in Russian flaxseed.

It is said that the average farmer buys the cheapest seed in the market and trusts to luck for results. This practice is condemned by experts, who declare that cheap seed is the principal source of the hosts of noxious weeds which spring up on many farms. Purity is a primary requisite to good seed, and adulterated seed is not pure. The adulterating matter may be worthless, harmless stuff, such as sand, dirt, stones, crushed quartz or dead seed, or it may be seed of harmful weeds, which so nearly resembles the genuine that the closest inspection fails to discover the fraud.

Grass and clover seed are the principal victims of the dishonest "mixer." A common method of adulteration is to mix the seed of wild and inferior grasses with that which commands a high price. A grass seed which sells for 12 cents a pound will be mixed with seed worth 20 cents, and the mixture will be sold at the top price, and under the name of the 20-cent seed. Some sample packages of seed labeled "Kentucky blue grass" were examined in one instance, and it was found that 35 per cent of it was made up of weed seed, dirt and chaff. A pound of "orchard-grass" seed in a package that was examined, contained 1,400 seeds of the sheep sorrel, a worthless weed. Nearly 100 samples of clover seed, bought of dealers scattered over the country, showed adulterations ranging from three ounces to forty pounds a bushel.

The reputation of American seeds dropped to such a low point in Europe because of the unscrupulous "mixing" done by American seed growers and dealers, that the United States department of agriculture started extensive and comprehensive pure-seed investigations. In Europe there are several "seed-control" stations where seed is tested, and seed investigation now is an important feature in many agricultural experimental stations in this country.

a personally conducted pure-seed investigation. The method of testing as carried on in an experimental station is as follows:

A fair average sample is secured, and this sample is divided into smaller average samples, so that several tests can be carried on at the same time. After this smaller average sample is weighed, the seeds are spread out upon a smooth-glazed black or white surface, and all of the impurities are carefully separated from the genuine seed,



By courtesy of the Canadian Pacific Railway.

EXPERIMENTAL FARM IN CANADA, PRODUCING SEED WHEAT.

The apparatus and appliances used in these investigations are complete in every particular and somewhat expensive, but any farmer or gardener can test his own seed and arrive at correct conclusions. The points to be considered are genuineness, purity, germinating power, and actual value of the seed. A good magnifying glass, a set of small bottles or tubes provided with corks, and a home-made germinating apparatus are all that is necessary to enter into

weighed, and their percentage ascertained. All chaff, sand and foreign mixtures of any sort are regarded as impurities. The seeds of weeds are identified, if possible, and every result is carefully recorded on blanks made for the purpose.

When the test for impurities is complete, the germinating test is made. Where the tests are made thoroughly two lots of seeds are taken for the germinating test—one for the germinating apparatus, and one for out-

door or greenhouse culture. For sprouting seeds it is necessary to have some sort of an apparatus in which all of the different factors governing germination, such as light, temperature and moisture, can be controlled, and this requires artificial heat which can be regulated.

Various forms of equipments are used; one of them consists of a square chamber made with double walls which are filled with water to preserve a low temperature. The lower part of the chamber is made of sheet iron and contains a Bunsen gas burner, connected with an automatic heat regulator, which is used to control the temperature. The upper chamber is provided with holes for the insertion of thermometers and for the admission of oxygen. The chamber is provided with shelves made of galvanized iron, and on these shelves are copper pans, in which the seed may be germinated in various ways.

Before the seed is placed in this or any other generating apparatus, it is soaked in distilled water or rain water from six to fifteen hours to hasten germination. The "sprouting bed" is made of some material which will soak up water, such as porous dishes, thick cloth, flannel or blotting paper, asbestos cloth, earth or sand.

The selected seeds are placed on or between the sprouting bed, and placed in the germinating chamber. The temperature is maintained at a uniform degree as it is in an incubator, and, in fact, the artificial germinating of seeds and the artificial hatching of eggs are alike in many respects, and a good germinator can be made out of an ordinary incubator. The seeds are left in the germinating chamber until they sprout, and the germinating value of the sample of seeds is found by counting the number of

seeds which sprout within the time allowed, and ascertaining the percentage of the whole number.

Usually the time allowed for seeds to germinate is as follows: Ten full days for cereals, clovers, peas, beans, lentils, sunflowers, cabbage, rape, mustard, flax, chicory, hemp, poppy and tobacco; fourteen days for beet-seed balls, rye grasses, timothy, earrots, etc.; twenty-one full days for grasses, except meadow and rye grasses and timothy; twenty-eight full days for meadow grasses, birches, alders, acorns, beeches, etc., and forty-two full days for white pine and stone fruits. Seeds which do not germinate within the specified time are counted bad, and, in the calculation, figure as such.

A simple home-made germinating apparatus can be made of a good-sized milk-pan, a porous dish, such as is used for setting flower pots in, and a pane of glass big enough to entirely cover the pan. The bottom of the pan is covered with water and the porous saucer is placed in the middle. In the bottom of the saucer a piece of thick blotting-paper or flannel is laid, and on this the seeds are spread, and then another piece of paper or cloth is laid over the seed and the pane of glass is placed over the pan. The paper or cloth is soaked in water before the seeds are laid in it, and the seeds are soaked from six to fifteen hours before putting them in the pan. The water soaks into the porous saucer and this keeps the "sprouting bed" moist enough to sprout the seeds. The atmosphere of an ordinary living-room is suitable, if care is taken to place the pan near the stove or in some warm place at night. The pan may be left partly open from time to time to permit fresh air to reach the seed.

With this apparatus, and a strong mag-

nifying glass to aid in separating the impurities from the sample to be tested, any farmer can ascertain the practical value of his seed. The sample should be a fair average of the whole, and it should be weighed and the seeds counted so that the proper percentage of purity and germinating value can be ascertained accurately.

For cleaning large quantities of seed from which to secure a test sample, a seed-cleaning machine is required. One used in an experimental station is like a fanning mill. This machine not only separates the chaff and dirt from the seed, but divides the cleaned seed into light and heavy seeds. All that this machine does can be done by a farmer with a number of sieves, varying in the number of meshes to the inch. With a number of such sieves the seed can be cleaned and separated quickly and cheaply.



EGGS AND HOW THEY ARE INSPECTED

Christopher Columbus had to smash an egg to make it stand upright. The men who inspect eggs could have shown the great discoverer how to make history without breaking eggs, for, by a twist of the wrist and a shake of the elbow, they toss eggs from one hand to another, lift them out of cases by the handful, finger the fragile things with a sleight-of-hand dexterity which is astonishing, and can make an egg balance itself on the edge of a case without even nicking the shell.

In the early days of the trade these jugglers of eggs were called "egg candler," because the lowly tallow dip supplied the rays which betrayed the interior economy of the product of hens' nests. But the

development of the industry and the adoption of the electric incandescent lamp for the light brought about a change of name, and the members of the craft are known as "egg inspectors."

A good brisk inspector, handling a fair run of eggs, can "candle" thirty cases of eggs a day; as each case holds thirty dozen, the day's run will average 10,800 eggs. The work is carried on in a dark room, in which the only lights are those used for inspecting the eggs. The condition of an egg is found by holding it to the light, and the degree of the translucency, color, spots and shape of the dark places determines the grade and character of the egg.

In Chicago and all large centers which have the electric light the incandescent lamp is used. But the candle by no means is laid on the shelf. Many inspectors claim that the incandescent light hurts their eyes, and that candle light is best after all, even though its modest flame flickers and sputters when the nimble fingers of the candler stir the air about it. The candle usually is held upright between three shingle nails stuck in the end of a short board, and the inspector holds the eggs close to and slightly above the flame, so that he looks down upon it.

Gas jets are used in some places and "natural" light is employed in others. When sunlight or daylight is used the window is completely covered except a space about four inches long and two inches wide. This opening is covered with leather and in it are two holes. The eggs are held up to the holes and "candled." The bulb of the incandescent light is enveloped in a sheet-iron hood, which has a small opening in the front part. The eggs are held up to this opening, two at a time, and inspected.

Any man can candle eggs if he "knows eggs," for the handicraft consists simply in holding the egg to the light, looking through it and classifying it according to its appearance. But—and the "but" is a large one—the man who inspects eggs must be able to distinguish at one glance the particular class to which the egg belongs, and egg inspectors recognize twenty grades. A clever man with a keen eye, a nice sense of discrimination, an adhesive memory and a well-developed knack of handling things may become a fair egg inspector in three years, but five years probably will pass before he is expert enough to go on the list of adepts.

The handling of the eggs is an important factor in the craft. Any man can pick up a single egg, hold it to the light, turn it round two or three times and lay the egg back in the crate again, but it takes an expert to pick up four eggs in one hand, three in another and by the mere working of the fingers roll an egg between the thumb and two fingers and then roll it out of the way to put another one in its place. Generally two eggs are picked up with each hand at a time, so that they are inspected in groups of four.

But the inspector does more than candle his wares, for he handles his own cases, lifts them to the bench, takes them down again, nails on covers, transfers eggs from one case to another and tells of marvelous curiosities in the egg line, which have passed under his fingers. He mentions three-yolk eggs; "double eggs" in which a perfectly formed egg, shell and all, is found inside of an egg; eggs with all of the colors of the rainbow in their shells; eggs with words and dates formed in the shell, and eggs with double and triple shells.

One of the many interesting "tricks" done by the men who earn their bread handling eggs, is that of transferring them from one case to another. Eggs are shipped and stored in cases, and are packed in strawboard compartments or "fillers," each of which is a tray and holds three dozen eggs.

A square sheet of strawboard lies under each filler. The inspector slips his hand



"CANDLING," OR INSPECTING EGGS.

under this sheet of cardboard and with his other hand on top of the tray lifts it, with its load of thirty-six eggs, out of the case, lays it over the empty filler and withdrawing the cardboard allows the eggs in the top tray to fall down into the empty one. This is a knack of the trade which requires but a trial by a layman to prove its elusive nature.

A strictly "fresh" egg is one without flaws of any kind. It may be ten days or two weeks old, but it is not more aged. This is called a "selected" egg and commands the highest price. When eggs begin to

grow stale the white shrinks, and this is shown to the inspector by a well-defined line in the large end of the egg. If shrunk too much for the first class, the egg goes into the "seconds," which also include fresh eggs that are "checked" or cracked.

A checked egg is a cracked egg, but the crack is not noticed until it is held up to the light or is rattled or "ticked" in the hand with another egg. A solid egg-shell gives a clear sound if ticked against another egg, but a cracked or checked egg gives out a dead, wooden sound. After the seconds come "spots" and "leaks." "Spots" are eggs in which the yolk clings to the shell and "leaks" are broken eggs. These are the general grades, but each of them is subdivided into grades recognized by the trade.

The best eggs are selected to be placed in cold storage warehouses from which they will be taken and sold when fresh eggs are scarce. They are carefully inspected before they are sent to the icehouse or cooler, and most of the inspectors are on this work in April and May, and sometimes the early part of June. During this period the hen is working overtime and sending fresh eggs to market; then she takes it easy for a time.

Eggs are kept in cold storage for seven, eight or more months. For the first three months they retain their original flavor and then they begin to deteriorate, and the longer they are kept the staler they become. When withdrawn they are inspected as though they were fresh eggs, and divided into similar grades. Pickled eggs are those kept in some lime or alkali solution, and salted eggs are preserved by being packed in salt. Of course, none of these preserved eggs is as good as the fresh article, but if

they pass the candler they are good enough to eat.

The inspector can detect preserved eggs at once and also can name the "icehouse," "pickled" or "salted" egg when it comes up. The icehouse egg is shrunk, its yolk is dark and it has a dull ring when ticked. The shell of a pickled egg is mottled and gives a metallic sound and the yolk is dark, and a salt egg has a shell which looks as though the salt had eaten into it. A pickled egg is apt to burst when boiled, for the lime fills up the pores so that the steam is confined.

A "blood-egg" is bright red when held to the light. In "yellow rot" the white and yolk solidify together and the egg shows yellowish red. A "watery egg" has an air bubble which floats on top, no matter how the egg is held. A "green" egg is pale before the light and shows a dark yolk. When broken the yolk is seen to be a dirty green in color. A frozen egg shows a crack reaching from one end to the other, and a double-yolk egg has two cloudy spots which swim round inside when the egg is turned, and a rotten egg is dense black before the light.

This is the way an egg inspector stands an egg on its point. He finds one that is somewhat "gone." Such an egg has a well-marked bubble or spot in the top. Holding the egg point down the inspector jerks it downward several times, so as to drive the heavier portion to the small end. Then he carefully balances it, and the egg stands up, straight as a soldier.

* * *

MINCE-MEAT MADE BY MACHINERY

Mince pie is Uncle Sam's national dessert. A celebrated Englishman who once visited this country apostrophized it as

"the incarnation and quintessence of American independence." The British have their tart, and the French their *paté*—both undoubtedly the works of genius in their way—but it remained for the Yankee to rise above the traditions of the past and conceive the idea of rolling the favorite desserts of both nations into one, adding a sprinkling of spice and a dash of cider, and inventing the expressive name "mince pie" for his creation. Unfortunately history does not record the name of the grandmother who first mixed mince-meat—she is one of the unlaureled and unsung benefactors of the human race. Yet as she sneezed over the nutmegs for the first pie, she may have seen, dimly, through the long vista of the future, the scrambling crowds of men and women around the "hot-mince" table at the "help yourself" restaurant. If she did, she had her reward.

But mince-meat making, for a long time the secret craft of the grandmother, has been reduced to a science, and mince-meat is now being made throughout the country in quantities to supply every man, woman and child in the United States with a pie a week all the year round. Besides a considerable number of pies are shipped over to England and France, where the former devotees of those inferior creations, the tart and the *paté*, are wondering vainly and enviously how the pies were made. When first exported, a French chef who has since become famous, invented a new kind of fruit cake or plum pudding, which was the delight of every epicurean palate and the despair and torment of all the rival cooks of Paris, who could not imitate the marvelous creation. But it was only mince-meat, just like mother used to make.

In the early stages of its evolution mince-

meat was no higher in the scale of culinary progress than ordinary hash. It was doubtless the ontgrowth of the Yankee housewife's "nearness." She had some scraps of meat left and some extra apples, so she chopped them up together and made them into a pie. Out of such humble beginnings mince-meat forced itself upward by sheer merit, until it stands shoulder to shoulder with apple pie.

At first mince-meat was made soft and juicy, and it had to be kept in a cool place in the cellar where it would not spoil. But there was a far sighted man named Allen who saw that it had a glorious future, and so he went to work studying its characteristics. After a while he found that it could be condensed in dry form so that it would outlast a piece of wedding cake. With the invention as a basis, a number of large manufacturing concerns have sprung up, several of which are located in Chicago.

The beef used in making mince-meat comes from the shoulder of the animal, and is cut in lean strips. It is taken at once in big trucks to the mince-meat factory, where it is thrown into a vat, in the bottom of which there is a coil of steam pipes covered with water. Here it boils away, stirred from time to time by a brawny workman, until the blood is all cooked out of the fibers. The room in which the work is done always has a rich, almost dinner-time odor. When the master workman thinks the cooking has gone far enough the meat is forked out and taken to the chopping-machine. This has a big basin which can be made to revolve slowly. At the center of it a shaft, to which are attached a number of knives, jumps up and down and cuts the meat, very much as a woman would cut it with a chopping-knife.

When it is fine enough the "batch" of 500 pounds of mince-meat is laid aside.

Dried apples are used, the finest grade that can be obtained in Michigan or New York. About 500 pounds of them, or a quarter of the future "batch" of mince-meat, are chopped in a machine similar to that used for the meat. When they are fine enough the workmen trundle them off to the mixing-room.

A small apartment opening from the chopping-room contains the spice mills. A great number of bags and barrels are standing at one side of the room and on the other side two machines, which resemble big coffee mills, are droning pleasantly. When the spices come in they are first ground in the mills to a fine powder and then placed separately in barrels. There are allspice, cinnamon, mace, citron, nutmeg, cloves, ginger and a very little pepper. The workman mixes them in just the right proportions, about fifty pounds of them being necessary to properly season a 2,000-pound "batch" of mince-meat.

The currants and raisins come in boxes, and before they can be used they have to be thoroughly picked over and cleaned. This is accomplished by pouring them on a fine meshed sieve through which all the particles of dust and the little pieces of stem will sift.

Now the ingredients are ready for mixing. The meat is poured into the bottom of a long, narrow trough standing on the floor, the apples go in on top of it, then the raisins and currants and the spices and the sugar. A few gallons of New York State cider are poured over the mass, and then half a dozen big, bare-armed men with shovels begin to turn over and mix the fragrant mass. When the mixing is com-

plete, the mince-meat is shoveled out into a truck, where it is allowed to stand several hours. It is almost dry and is rich and tempting.

The packing-room is full of animation. Around a long table stand a score or more of girls in white caps and aprons. Before each of them there is a pair of iron rods, crooked at the end and standing upright in the table. By a motion of the foot the girl can force the rod down until the crooked ends slide into two little boxes, just as a pumpdasher slides down into a pump. The mince-meat is placed on a traveling belt which runs along the table and the girls take it in handfuls and pack it into the little boxes before them. Then the rods come whirring down and compress it into a solid block hardly larger than a cake of stove blacking. This block weighs twelve ounces and will make three pies. It is passed along to a girl who wraps it up in oiled paper and slides it into a little pasteboard box, after which it is ready for shipment.

About 15,000,000 pounds of mince-meat are made annually in the United States, and it is consumed largely in the big cities, the country housewife still preferring to follow in the footsteps of her grandmother and make her own mince-meat.



BUTTERINE AND OLEOMARGARINE

While the Prussians were encamped around Paris during the siege of 1870-71, the Frenchmen inside of the beleaguered city awoke one morning to find that they would have to eat their bread without any butter. It was one of the first intimations that the supply of provisions was running short,

and it lent color to the fears already expressed that the city would be conquered as much by starvation as by the Prussians.

One by one other commodities disappeared from the stalls and markets, and the prices rose higher and higher. Yet a few days before the capitulation a sign appeared in the market place advertising butter for sale, and although there was a rush to purchase, the supply seemed inexhaustible. At first the street throngs thought that some avenue had been opened through the Prussian ranks for the transportation of food, and the joyful rumor quickly spread over the city. But the butter had not come through the lines. An ingenious inventor named Mege Mouries, spurred on by want and necessity on every hand, had made it in a Paris factory. That was the beginning of the oleomargarine or butterine industry.

The French found that the new compound was not only good to eat, but cheap and wholesome, and since that time the manufacture has grown immensely and the capital invested runs far up into millions. Much of the world's product is made in Holland from oils transported from this country, but the Chicago and other American factories supply not only all the American trade but have a surplus to ship in all directions.

The manufacturer of butterine merely uses a new way of producing a well-known food product. He does by machinery what the cow does by the laws of nature. By analysis certain ingredients are found in butter, and oleomargarine is made by obtaining them from some other source and combining them in the correct proportions. One of the principal of these is olein, an exceedingly rich oil secreted by the udder

of the cow. The discoverer of the new process argued that if olein was found in the milk it would probably occur elsewhere in the animal, and by analysis he learned that caul-fat, which forms a cushion and blanket for the intestines, was rich in the substance. It was a comparatively simple process to extract the olein and make it the basis of butterine.

In one of the great Chicago factories a whole building is devoted to obtaining olein or oleomargarine oil, as it is more familiarly called, from the caul-fat. As soon as the fat comes into the manufactory from the slaughter house it is dumped into a vat of water, where all the blood and dirt are thoroughly washed away from it. It is then carried to an upper floor, where it is poured into a row of iron kettles, provided with steam jackets for heating purposes. Here the temperature is carefully raised to 155 degrees—at a higher temperature than that the fat will burn—and the oil slowly tries out, assisted by revolving toothed shafts not unlike the agitators of an ice-cream freezer.

When the skilled eye of the workman sees that the fat has been sufficiently heated it is drained to the next floor into large, cool kettles or clarifiers, where all the dirt and refuse, if there are any, settle to the bottom. The clear oil is then drawn out into tin-lined trucks by means of a siphon, and trundled away to a big room, where it is allowed to cool and granulate for three days at a temperature of 85 degrees.

At the end of that time it is sent downstairs to the press room. This is a busy place. All the men are clad in neat white jackets and their sleeves are rolled to their shoulders. The truck, with its yellowish white contents, is wheeled to a little table,

around which four men are standing. In front of each there is a small rectangular box open at the top and fastened to the table. Over this the workman spreads a piece of stout white duck. Enough of the tallow oil is dipped up to fill the box, and then the next workman takes it in hand, folds the top of the duck over the soft mass and passes the cake up to the man on the presser. This machine consists of sixty pieces of sheet iron loosely fastened at the ends to shafts. Between each pair of these plates eight of the little white duck packages of tallow are placed, and when the whole machine is full, pressure is given by means of a screw at the top. As it increases gradually the oil is squeezed out through the duck and drips downward into a trough. Of the fifty pounds of fat to an animal, twenty-nine pounds are oleomargarine oil. When the pressure is removed the flattened duck packages come out filled with a pure white cake, an almost tasteless substance known as stearine, which is used as an ingredient in making certain brands of lard. The oil as it runs from the press is ready for use in the making of butterine. Part of it goes directly to the factory near at hand, and part is barreled for shipment to Holland.

The oleomargarine factory is a most interesting place. On entering the building a visitor is struck almost at once by the scrupulous cleanliness of the floors and tables. They are polished and repolished, until they are almost as white as the proverbial New England kitchen floor. All the employees throughout the building are clad in white jackets and aprons, and the girls in the packing rooms wear dainty white caps.

The process of making the oleomargarine

begins on the third floor of the building. Here in one corner of the room a stream of oleomargarine oil of a bright amber color is pumped into several large steam-jacketed kettles, where it is kept stirred by means of dashers similar to those in the trying-rooms. The temperature is carefully raised to 185 degrees to melt the oil thoroughly, and then it is conveyed into large tin-lined vats, where it is stored and chilled. It is then passed through a bath of brine, where it is washed and deodorized, and when it comes back it looks a good deal like light brown sugar, and has a distinctly buttery taste. It is packed in tin-lined trays about six feet long by three wide, and placed in a cool storeroom until it is needed for use. Everything about this storeroom must be kept free from dirt, for the reason that the oil, like butter, is so sensitive that it readily takes up foul odors. A single drop of kerosene in the room might taint and ruin a whole supply of oil.

Into the storeroom, "neutral," as it is called, or the purest leaf lard, which has gone through the process of deodorizing in brine, is brought and stored. As these two parts of the oleomargarine, both of which are practically without taste, are needed, they are trundled out on trucks, and two workmen with their sleeves rolled up shovel them in equal parts into the flaring tin funnel of a chute which leads to the creamery below.

On reaching the next floor the mass falls into a big vat or churn, heated to 180 degrees, and is rapidly stirred by two men with wooden paddles until the lumps all disappear. To assist in this operation small sieves are also used. When the mass has been rendered homogeneous a certain quantity of genuine butter and buttermilk,

sometimes to the amount of 20 per cent of the whole, is put in, together with a little butter-color of the same kind that is used in ordinary creameries, and the stirring goes forward again. The genuine butter used is churned in a revolving churn near at hand, the milk being purchased and collected in exactly the same way as in a creamery. In fact, one end of the oleomargarine churn room is nothing but a small creamery. The cheaper grades of butterine do not contain quite as much butter, and they are usually churned by machinery instead of by hand.

When the oleomargarine comes from the churn it has very much the appearance of butter. It is dumped on a circular table, and a long, conical butter-worker operated by machinery squeezes out the buttermilk and works in the necessary amount of salt. A man in a clean jacket helps along the process with a wooden paddle. When the butterine has been sufficiently worked and loaded into one of the tin-lined trucks it looks like real butter, and no one but an expert can tell it from real butter. The creamery has a capacity of 20,000 pounds in twenty-four hours, and 100 men and 100 women are required to do the work.

After standing one day in a clean, cool storage room, and then being reworked, the oleomargarine is taken downstairs to the packing-rooms. Here white-jacketed men and girls stand at tables with mountainous heaps of the moist yellow butterine in front of them. With a deft movement a man scoops up a handful and plasters it into a mold holding one pound. Then he drops it out before a girl, who wraps it up in a piece of parchment paper, and it is then packed away in boxes. In this department

the greatest care is taken to have everything sweet and clean. The floor and all the tables are scrubbed at least once a day.

All the boxes and firkins have to be marked and stamped with great care; for Uncle Sam is very particular about butterine, and when a manufacturer wishes to make it he has to pay a license fee, and there is a further tax on all the product manufactured. Each package must bear the factory number and the name "oleomargarine" in plain type, so that no one will be mistaken and take the product for butter. Besides this, many of the states have separate laws on the subject which more or less restrict the sale. But in spite of all these impediments an enormous quantity of the product is manufactured and sold every year. Many persons prefer it to butter, especially in the large cities.

Chemically butterine is almost identical with butter. Here is the analysis of the two:

	Butterine.	Butter.
Water	12.01	12.13
Palmitin	18.31	16.83
Stearin	38.40	35.39
Olein	24.05	22.93
Casein .....	.74	.48
Salts	5.22	5.22
Glycerides of the lower fatty acids	1.26	7.01



PEANUTS AND THEIR USES

The American peanut industry flourishes mostly on account of the craving of the small boy. Wholesale commission merchants and grocers ship the raw nuts from the south in great, rough sacks, and they are sold out in small quantities to the street-corner fruit venders. But the charms

of the pudgy bag with its two little ears hold their own with difficulty against the wedge of sticky candy with its conglomeration of nuts. Besides the sale in these forms confectioners within the last few years have been making a good many salted peanuts, and some persons prefer them to almonds.

But outside of the consumption of peanuts in these forms—and the voracity of the small boy makes the quantity enormous—the peanut has other increasing uses in this country. The manufacturers of health foods and cereals are beginning to use it in various ways. Many a table has peanut sandwiches with salad dressing frequently served, and peanuts are used in omelets and with other fancy cooking. Furthermore, many a person with epicurean tastes who orders a salad at a downtown restaurant, and pours over it what he believes to be a rich oil of the olive, is using only a product of the humble peanut. Indeed, so fine is the peanut oil made in foreign countries, that it is difficult for even the most expert dealers to tell it from the genuine olive oil. Being a great deal cheaper, it is therefore much used as a substitute.

The manufacture of peanut oil in Marseilles, France, and in Germany, has grown to be, within the last ten years, a great industry. The peanuts used come from the east and west coasts of Africa, Mozambique, India and the United States, and a very few from the Argentine Republic. The best grades for the production of oil come from the valleys of Senegal in Africa, yielding about 51 per cent of oil in weight. The American peanut is smaller in size, but much finer in grain and of a far better flavor. The oil, however, is

not of as good a quality, and the nuts yield only about 42 per cent of oil.

The process of expressing the oil is similar in a good many respects to that used in the cotton-oil mills of the south. Most of the nuts are imported shelled, owing to the greater ease with which they are shipped. As soon as they reach the factory they are placed in a machine which resembles the American fanning mill for wheat, and the dust and pieces of shell are blown out. They are then ejected into a cylinder, through which they are propelled by an Archimedean screw to a pair of heavy iron rollers, through which they pass and are crushed. These rollers are so constructed with springs that if a hard body, like a pebble or a piece of iron, gets between them, they will spread apart enough to let it through.

Passing the first crushing machine the partly broken nuts are carried forward to the second, where the pressure is greater, and they are again crushed. From here they are bolted through a sieve, the finer peanut "flour" as it is called, shaking through, and the coarser remaining to be ground over again. The flour is conveyed along by means of another Archimedean screw to a pair of mill-stones, similar to those used in an old-style flour mill. As it sifts out of the spout it is carried to a large vat, where it is slightly heated and then pressed into "scourtins" or woven bags of horse hair. The scourtins are conveyed to the hydraulic machine, where they are subjected to the tremendous pressure of 2,850 pounds to the square inch, and left for an hour. At the end of that time all the oil that can be obtained in the first yield, about 40 per cent, has been extracted. This is the most valuable product of the nuts. It

readily brings from \$7 to \$8 per 100 pounds, and is a fine, clear oil of about the color of olive oil.

After the first pressure the meal is removed from the scourtins and raised to a temperature of about 158 degrees, after which it is again pressed and this time yields about 13 per cent of oil. This second pressing is worth only about half as much as the first.

Besides the use of the oil for salads it is extensively devoted to the manufacture of fine soaps, for which France is noted. The greater proportion of it is consumed in this way. The finer parts of the first pressing are also used extensively in the manufacture of oleomargarine and other compounds placed on the market as substitutes for butter.

The shells and husks of the peanuts are sometimes ground up and fed to cattle, but for the most part they are regarded as valueless. But the refuse left in the scourtins after all the oil has been extracted, is becoming yearly more valuable. Indeed, it is now regarded in Germany as the main product of the oil factories. As a food for cattle and sheep it has a value of \$30 to \$40 a ton. It is also fed to horses in cold weather, but in summer it has been found to be heating. Within the last few years its usefulness has been much extended by the preparation in Germany of peanut flour for the use of the army and for general consumption. It is exceedingly rich in nitrogenous substances, and is therefore an excellent substitute for meat.

It is made in several forms: First, peanut-grits, the coarse meal dried, purified, bolted and packed in papier-mache boxes containing one German pound, and sold at retail for 12 cents each. In this form it

is used for soups and cakes. Peanut-flour, the second product, is much finer than the grits and it is a most palatable dish. When cooked it tastes a good deal like oatmeal. Peanut biscuits or crackers are the third manufactured product, and they are said to be not only toothsome but nourishing. A biscuit is also made with the addition of a little chocolate for the use of persons suffering from diabetes or from excessive stoutness. Its richness in protein, and its low proportion of carbohydrates, like starch and sugar, give it its medical value.

Extensive experiments have been made in Germany in feeding the inmates of the hospitals, and, although many of them were afflicted with dyspepsia and other alimentary diseases, it was found that the peanut-flour food was not only enjoyed by the patients but well assimilated. The German government has also tried it as rations for soldiers, and it will probably be more extensively used in the near future. Peanut-oilcake food may, before many years, be as common on the restaurant bills of fare in American cities as buckwheat cakes.



IN A MACARONI FACTORY

Each year the Americans grow fonder of macaroni. They are pressing the Italians hard, as lovers of the flour-paste tubular dainty, and every restaurant now is prepared to serve up macaroni, spaghetti and vermicelli in a dozen different ways. Italians brought to this country with their appetite for macaroni the tools for making it. All they needed besides the tools were flour and water, and little macaroni factories sprung up in New York and Chicago. In them the macaroni was made as it has been made in Italy for a century or

more. The kneading, mixing and other parts of the simple process were all done by hand, until the Americans happened to think that the macaroni business was bound to grow, and then machinery began turning out the tubes.

In Chicago, not far apart, are two macaroni factories. In one, Italians with bared arms work over the flour and carry it through all the processes by hand. In the other, the paste is kneaded under iron knuckles, rolled beneath granite boulders, and squeezed into long tubes by steam power. The machine can turn out more macaroni in a day than the Italian can, but the Italian's factory is more interesting to the man who wants to know how macaroni is made.

Only the hardest and flintiest wheat is used to make macaroni. Hard Minnesota and Dakota wheat is the best. The Italian takes his wheat, washes it and dries it carefully. After it is dry, the wheat is ground or pounded into coarse, cracked wheat, and it is then put into a revolving screen which is turned by a crank. This screen makes the first separation, dividing the starch, bran and hard parts of the wheat. Then the broken wheat is sifted through a number of hand sieves, beginning with a coarse mesh and ending with a fine mesh. The knack of swinging the sieve, tossing the grain from one side to the other, and bringing all the bran to the middle or on top, is acquired only after long practice, but when the broken wheat has gone from one sieve to the other it is clean, bright, free from bran, and almost polished. In this stage it is called semolina.

The coarse flour is next mixed with warm water, and kneaded by means of a lever which has on it a three-faced block of wood,

with the sharp edge of the prism down. Two men work this lever and block of wood into the dough, sometimes with a chopping motion and then sidewise. A spring lifts up the levers so that the men have nothing to do but bear their weight on it to force it down.

After it has been kneaded and worked for an hour or so, the dough is ready to be made into tubes. This is done by pressure. The dough is placed in a cylinder, which stands upright, with the top open, but the bottom is closed with a perforated plate, the holes being the exact size of the macaroni sticks. A quantity of dough is put into the cylinder, and then a plunger is put on top of the dough. Half a dozen men take hold of the lever and bring it down, and fifty soft, pliable macaroni tubes shoot through the perforated plate.

The sticks are made hollow by means of little round plugs, held in the center of each hole by pins. Of course, these pins split the macaroni into two half-tubes as it passes through the perforated bottom of the cylinder, but the dough is sticky and joins together again, below the pins, so that the tubes show no signs of having been separated. While the unacaroni sticks are coming through the perforated plates, they are fanned briskly to keep them from sticking together, and they are cut off about every ten feet, and hung over wooden frames, where they are kept until dry, hard and brittle.

Italians are the workmen in the American factories too. They first put about 100 pounds of the semolina into a mixing machine. This is of iron, about three feet deep and two feet in diameter. Down the center is an upright shaft, which has round bars of steel sticking from it

like quills on a porcupine. The broken wheat, mixed with hot water, is worked into a dough by the steel bars moving around in the mixture, and when the dough is stiff enough it is taken out and put into a rolling machine. The rolling pin of this machine is a granite wheel which looks like an enormous grindstone and weighs about three tons. This granite roller moves around in a circle over the dough, which is placed in a circular strip on the wooden bed around the edge. For three-quarters of an hour the granite rolling pin squeezes the macaroni dough until it has a satiny feeling.

Next comes the kneading machine. In this machine conical shaped iron-cogged wheels dig their hard knuckles into the dough and thoroughly work out any hard spots that the granite roller has missed. After half an hour in the kneading machine the dough is ready for the press. The cylinder of the press is somewhat like the hand press of the Italian, only it is larger and stronger, for a pressure of 1,000 pounds is brought to bear on the dough, squeezing about 100 pounds of macaroni in three-quarters of an hour. The macaroni tubes are cut off every ten feet, and then are taken to a table where they are cut into proper lengths for packing. Then the macaroni is taken to the drying room, and kept there on racks for eight days, when it is packed in boxes for shipment.



VINEGAR AND ITS MANUFACTURE

No farm cellar in the apple region is quite complete without its vinegar barrel. Each fall as soon as the sweet cider comes in from the presses, a part of it is funneled into a dusty barrel that occupies a place

in the corner of the room. It is given every opportunity to turn "hard" and then sour, as sour as the sourest vinegar. Sometimes the housewife hurries the operation by adding a little "mother" — the thick, velvety growth, a product of fermentation, which sometimes rises in her cruets and jugs. By the next spring or summer, if conditions have been favorable, the cider has become vinegar and is ready for use with the early lettuce.

But that is a slow process and only small quantities are made at a time. If the city epicurean depended on such a source of supply, he would have to take his salads without the acid element. For this reason great manufactories have sprung up, and many of them weekly make more vinegar than all the farmers of Michigan or any of the other apple states make in a whole year.

The visitor is warned of his approach to a vinegar factory while yet a long way off. There is a pungent odor not unlike that of long confined smoke, and the atmosphere for blocks in every direction fairly reeks with it. On approaching nearer it grows more and more acid, until inside of the building one has the rather novel sensation of tasting air. It is almost equal to eating pickles.

Vinegar is of two or three different kinds. The most expensive is made from red wine, and is of a deep purple color. It is very strong in acid, so strong, indeed, that it fairly bites the tongue. It costs about 40 cents a gallon. Then there is the cider vinegar of farm fame, and it is most popular of any for general household use. It retails from 12 to 16 cents a gallon, and it may be said in passing that some disreputable concerns make a variety of "cider" vinegar that is wholly guiltless of apples. Great quantities of white-wine vinegar are

also made, usually from corn and rye. It is perfectly colorless, very sharp to the taste, and is usually used for making pickles and condiments of various kinds.

The process of manufacturing this white-wine vinegar is most interesting. In the first place, the manager starts out just as if he were going to make genuine corn whisky, but when he gets part way through with the work he suddenly switches off and the product is vinegar. The corn and rye come to the side of the factory in cars, and are elevated to the top floor, where they go into big bins. In the morning when the superintendent gives the word, a workman pulls the slide from a spout that leads down through four stories and into the top of the cooler, a huge iron boiler holding 100 bushels. The corn comes rattling down, and it is soon boiling away under a steam pressure of sixty pounds. At the end of two hours it has been reduced to mash—a well-known whisky term—and is quite toothsome enough to tempt any cow home from a June pasture.

It is now blown through a pipe leading upstairs to the great mash-tubs, holding 8,000 gallons each. Here fifty bushels of malt, fresh from the maltsters and ground to a pulp in a little mill on the next floor, are dumped in, and two awkward paddles begin to revolve, churning the mass until it looks like the surface of a geyser.

The cooking of the corn separates the starch, and the addition of the malt, together with a temperature of 148 degrees, turns the starch into sugar. At this period of the process the mash has a really sugary smell, like molasses candy on the back of the kitchen stove. After being beaten and churned for three or four hours, cold water is turned into a coil of pipes in the bottom

of the huge tub to cool the mash. In the meantime some workmen have been preparing the yeast in a little room at one side. Malt and rye are boiled together in a copper-lined kettle holding 200 gallons, and, a little of the yeast ferment being added, the plant begins to grow. When the process has gone far enough, just the right proportion of the yeast is taken out and “planted” in the mash-tub, where without more ado it begins to make itself felt.

Now the mash is allowed to slide down through a pipe to the fermenting tanks, where it sizzles and bubbles away for seventy-two hours, hard at work fermenting. The alcoholic spirits are being slowly extracted by the “working” of the sugar. Thus far the process has been almost identical with whisky-making.

A busy, clugging link-pump now sends the mash upstairs to the stills—real whisky stills, except in the use of “worms” or coils of pipe for collecting and condensing the alcoholic spirits. A “worm” would be used in vinegar manufacture, but Uncle Sam is afraid that some day a very well-meaning charge of corn might by some mistake turn to whisky instead of vinegar. Uncle Sam always looks after such things in a prompt and business-like way.

The alcohol is forced out of the mash and into the still by means of steam, which rapidly vaporizes it. The pipe in the still is surrounded by cold water, which quickly condenses the alcohol and collects it below in a receptacle. All the rest of the mash—“slops,” as it is known to the vinegar man and the whisky man—is carried off to one side where it is stored up ready to sell to the stock raiser for cattle feed. It contains all the corn except the alcoholic parts, and it therefore makes very rich food.

The spirits are now pumped to the generators, the only distinctive vinegar-making devices in the whole process. These consist of tall, cylindrical tanks of white wood, bound with iron hoops. They extend from floor to ceiling, with an appliance on top for allowing the alcohol to trickle in and a cock at the bottom through which the vinegar may be drawn off. Several floors are covered with these generators as thick as they can stand, and the visitor who goes among them is compelled to sneeze in deference to the pronounced acidity of the atmosphere.

The tanks inside are filled from top to bottom with beech shavings—nothing more. When the alcohol drips in at the top, it spreads over the shavings where the air has ready access to it. The oxygen pounces upon it and changes it without more ado into acetic acid or vinegar, in which condition it runs out at the cock and into a trough that carries it down to the next floor into a huge storage tank. The shavings in the generators are merely for the purpose of providing a great amount of surface over which the spirits must flow.

After having seasoned for a time in the tanks, the vinegar is pumped out into barrels, labeled, and sent all over the country to the pickle manufacturers. Every bushel of corn makes about four gallons of white-wine vinegar, which sells at all the way from 7 to 10 cents a gallon.

The cider used for vinegar comes almost entirely from Michigan, Ohio and New York, enough being secured every fall to last a whole year. The barrels are corded up in endless rows—a whole great room filled full, with only little alleyways piercing it—and allowed to stand until the cider is quite hard enough to make an old cider-

drinker dizzy-headed. When at last it has sufficiently fermented, it is run over the shavings in the generator and becomes a light-brown cider vinegar. It is now run into old whisky barrels, and allowed to stand as long as possible. The whisky barrels assist greatly in the ripening process, which so much improves vinegar. Only a few firms in the country have this method of making their product more palatable.

Red-wine vinegar is made just like cider vinegar, a shade greater care being taken, perhaps, to keep it clean and pure. The wine used comes largely from California and Ohio, which of late years have been making a good deal of it. The factory can easily turn out eighty barrels a day, and when one considers that a teaspoonful at a meal is a very large average for the ordinary adult, it will be seen how far such a quantity will go. The prices are now so cheap that the farmer can hardly afford to make vinegar, even for home consumption. He can sell the cider to better advantage.



HOW FRUIT FLAVORING EXTRACTS ARE MADE

Since soda water became the regular dissipation of the summer girl, the extract-making industry has assumed enormous proportions. Where ounces of lemon and vanilla were used by housewives and chefs a dozen years ago, gallons are now consumed in the corner drug store. To accommodate this great growth in business, manufacturing plants have sprung up through the country, and they are yearly adding to their equipment in order to supply the ever-increasing demand.

Vanilla comes almost entirely from Mexico, in the form of long, brown, shiny

beans, which are tied up in half-pound bundles and kept in hermetically sealed receptacles, so that the rich odor may not be dissipated in the air. The bean grows on a peculiar vine which is said to derive quite as much nourishment from the air as it does from the soil. It is planted in cuttings by the Mexicans, and as it grows it is trained on lattices or palm trees. In the third year it begins to bear, and for thirty summers the crops continue good. In a single month the vanilla bean will grow to its full size, but requires fully six months longer for it to ripen.

After the beans are picked—and their value depends largely upon having them neither overripe nor underripe—the peculiar rich aroma is developed by a complicated process of fermentation. They are first stored under cover until they begin to shrivel, and then they are sweated by heating and inclosing them in air-tight boxes over night. In the course of two or three days the beans have obtained a rich brown color, and present a moist appearance. After being exposed for several months in the sun to dry, they are packed in little bundles and shipped to the United States, which is the greatest extract-making country in the world. Thousands of Mexicans make their entire living by raising and curing vanilla beans. The cost ranges from \$6 to \$12 a pound, according to the length and quality of the beans, the prices being now pretty high owing to the large demand and the insufficient supply. For this reason vanilla extract is frequently adulterated with tonka or snuff beans, which cost only \$2 a pound. They impart a very pungent odor, and a somewhat sharp and bitter taste to the extract.

The unpacking room of the extract fac-

tory is as fragrant as a little corner of Ceylon. When the workmen open the tin cans, each of which contains about thirty pounds of beans, the rich aroma rushes out, filling the room. The beans are taken from the bundles and placed in chopping machines that resemble a sausage-cutter, from which they come out as fine as mince-meat. A quantity of the best lump sugar is now mixed with the mass, according to a secret formula, and the whole fragrant "charge" is thrown into a big jacketed kettle. Here the temperature is gradually raised by means of steam, and retained at about the boiling point for forty-eight hours. The sugar absorbs the aroma to a large degree, and when the "charge" is taken out it strongly resembles the grounds of coffee after the liquid has been poured off.

A certain amount is now poured into a twenty-gallon keg, five gallons of deodorized spirits are added, and the keg is placed in a great storeroom where hundreds of others just like it are arranged in long rows. Each keg is labelled with the date of entrance, and at the end of a full year, during which time the alcohol has dissolved all of the vanilla from the sugar and from the pieces of bean, it is ready for the next process. The kegs fill the whole of one great storeroom, and they are valued at more than \$150,000.

The kegs are emptied into a large receptacle, and the liquor of vanilla, as it is called, is forced under great pressure through an ordinary filter press, where the impurities, including the bits of vanilla bean from which the essence has been extracted, are removed.

The stream which flows from the press is of a deep brown color, and the odor suggests cakes, ice cream and a great many

other good things. It is the pure vanilla extract. After being allowed to stand for a day or two in a small tin tank, the vanilla is drawn off into small receptacles provided with a faucet at the bottom. In this way it goes to a long table, around which a number of neat-appearing, nimble-fingered girls are sitting. One of them fills bottles of sizes varying from one-sixteenth of a pint to a quart, another plugs in the corks, another pastes on the labels, another slips the bottles into small pasteboard boxes and then a man comes and carries the bottles away to be packed in sawdust and sent out to the market.

Vanilla is a rather expensive food commodity, and unless the supply of beans from Mexico can be largely increased during the next few years, it is destined to go still higher. Vanilla has been growing popular within the last few years. Originally there was at least three times as much lemon sold as vanilla, but now the comparative amounts have almost changed places.

The process of making lemon extract is not so difficult as that of vanilla. All of the best essence or oil used by manufacturers comes from Sicily, where the best lemons in the world are raised. The crop is harvested in November or December, the best and largest fruits being picked and packed for shipment to the big cities of Europe. Just before the small and imperfect fruits are entirely ripe, they are picked and divided into sections. After lying in the sun for a day, the lemons are taken, one by one, by Sicilian girls, who scrape off the pulp and squeeze the lemon oil from the rind out into a sponge. When the sponge is completely saturated it is pressed and the oil runs into a specially made copper vessel, which can be hermetically sealed

as soon as it is full. A good workman will squeeze a pound of oil or essence every day, the market price of the oil being \$2. It takes from 400 to 500 fruits to make a pound of oil.

In this form it comes to the Chicago factory. To get it out of its sealed case the workman chops holes in the copper with an ax, and the oil to the amount of twenty-five pounds runs out. The first process in preparing extract of lemon is the removing of the balsamic oils. Many persons will remember having eaten cake or ice cream which had a distinct taste of turpentine. This was probably owing to the fact that the lemon extract was a poor brand from which the balsamic oils had not been removed. The process is entirely secret, each manufacturer having his own methods of doing the work.

When the oil comes out it is yellow and almost clear, with the delightfully pungent odor of lemon-rind. It is now "cut" with deodorized spirits and then sent into the filter room. This is a great apartment containing tables loaded full of big glass bottles. In the top of each there is a funnel fitted with ordinary druggist's filter paper. Everything is kept scrupulously clean, so that the filtering may go forward without allowing the liquor to collect any dust. There are hundreds and hundreds of these bottles and funnels, and it keeps several girls busy all the time, pouring the liquor into the filters. The room smells like a doubly concentrated Sunday school picnic, where a whole bevy of girls are making lemonade. When the liquor is strained through into the bottles it is clear and yellow, ready for bottling. One pound of oil makes, with the spirits added, one gallon of extract.

When the cook uses vanilla or lemon the process of seasoning is simple. As soon as the cake or custard into which the extract has been put is heated, the spirits holding the real essence in solution are volatilized and driven off, and the essence remains to give flavor and aroma to the cookery.

Orange extract is made exactly like lemon, the oils of the two fruits being hardly distinguishable when they arrive at the factory. The same factory makes extracts of cinnamon, chocolate, almond, nutmeg, cloves, celery, ginger, onion, allspice, and many more, the process in several cases being exceedingly complex and difficult and usually hedged in with secrecy.

Extracts from the fruit of the strawberry, the pineapple, the raspberry, the banana, the pear and the apricot cannot be made, although many experimenters have worked on the problem. These fruits contain so much water that it is impossible to get them condensed enough to secure the true essence. Artificial extracts with the flavors of these fruits may, however, be made. The process is entirely chemical, and the flavors produced are really stronger than the fruits themselves. Many of these extracts are used in cooking and in soda water fountains, but they are all more or less injurious to the health. The proprietors of many of the best soda fountains refuse to use them, preferring to keep a supply of crushed fruits always on hand. Peach extract is made from peach pits.



EXTRACT OF BEEF AND ITS PREPARATION

After many centuries of absolute sway over the destinies of the kitchen soup-kettle, the place and power of the soup-bone

is being rapidly usurped by extract of beef. It is so easy and convenient for the housewife, especially if she happens to be a member of the Ibsen society or the Browning club, to take a teaspoonful of black paste out of a little earthenware jar, stir it up in a sauce pan, sift a pinch of pepper and salt and possibly some vegetables, and announce that soup is ready.

Of course this short cut to culinary success will be decried by the New England housewife, who sees the art of her ancestors being thus reduced to a science which any one may master. Her way was to buy the soup-bone herself, being very particular to see that it was a white, juicy joint, with as little meat clinging to it as possible. Then it was ensconced in a kettle and allowed to simmer away all the forenoon, filling the house with the suggestions of a far-away dinner. It was peppered and salted and sipped from time to time to see if it was just right, and when the soup was done it was, of course, delicious.

But the extract of beef method is much more compatible with this latter day hurry and worry, and there are those, even among the housewives whose grandmothers were veritable geniuses at cookery, who have wandered so far from grace as to insist that soup made by the new method is better in flavor and richer than the old style soup.

Extract of beef was invented in South America a good many years ago. Down in Uruguay, Paraguay and the Argentine Republic, vast herds of half-wild cattle roamed the pampas, and the drovers who owned them, by right of being expert with the lasso, found that it hardly paid to slaughter them owing to the absence of a market for the beef. Some of the quarters

were "jerked," or dried in the sun, and the hides had a value of their own, but the rest of the carcass was ordinarily left to decay in the hot southern sun. At last some man, whose name certainly ought to decorate the pages of history, discovered a way of boiling down the beef, very much as the old-fashioned nurse made beef tea, until the nutritive portions had all been extracted.

After certain filtering processes it was bottled up and sent over to Europe, where it was sold as a tidbit to tickle the palates of the aristocracy. After a time, like everything that economizes labor, it was successful, and every-day people who ran to their luncheons with their heads seething full of figures began to eat it. And once established as a food commodity, the beef-packers of other countries began to devise means of improving it. Chicago took the lead in the work, and to-day the best extract in the world is made in the stockyards packing house of that city.

While the principle of the processes connected with its manufacture is simple enough, the actual mechanical operations are full of complexities, great care and skill being necessary to secure a product which will be acceptable to persons who know what good soup is.

In the first place, the beef is cut from the cattle in the slaughter house. It is mostly fine, lean meat from the forequarters, no shanks or gluey parts of the animal being used. After being thoroughly washed it is loaded into trucks holding about 2,000 pounds, and trundled away to the cooking department, a long room almost filled with two rows of round copper boilers or "kettles," as the men call them. These consist of an upper and lower hemisphere, so built that they can be fastened together hermeti-

cally. The lower hemisphere is built double like a custard-cooker, the intervening space being filled with hot water. From the upper hemisphere, which is punctured with a huge, cyclopean eye-glass, there extends a pipe, which is connected at the further end with a vacuum pump.

The charge of 2,000 pounds of meat is placed in the kettle with a little water, the air is pumped out, and the hot water is turned into the jacket. After six or eight hours of cooking the meat is thoroughly disintegrated, and the liquor which surrounds it is thick and pasty. The workmen know when the cooking is complete by examining the mass inside through the glass window. The whole secret of this process is to cook the beef at a low temperature to avoid scorching, and this is done by boiling in a vacuum. In South America no such care is given to the process, and the extract is often very black and bitter.

The liquor is now drained off and clarified by a secret process, after which it is pumped through two or three filter presses, one after another. The filter presses are constructed of solid-iron, corrugated, double-concave disks punctured in the middle and separated with layers of ducking which catch any impurities and retain all the fibers still left in the mass of extract.

From here it pours into a vacuum pan 7 feet high, 12 feet long and 6 feet broad. The entire bottom part of this is filled with steam coils and from the top a pipe runs to the exhaust pump. Enough extract liquor is allowed to flow into the pan to cover the pipes, and here the free water in it is quickly evaporated, the heat and the vacuum both assisting the process. From the first vacuum pan the extract passes to the second, and when it at last runs out it

has been condensed to a thick brown paste, containing only about 20 per cent of moisture. In this condition it goes to a mill of the kind used in grinding paint, where it is rendered thoroughly homogeneous.

The packing room is a marvel of neatness. Around a long, narrow table a score or more of girls are arranged, each in a tidy dress, and a natty white cap and apron. The first two or three in the row fill the little white crockery jars one by one from a spout which brings the extract down from the room above. Another girl deftly plugs a cork into the jar, and then in quick succession it is capped, labeled and wrapped ready to go to the boxing room.

Each pound of the extract contains all the nutritive matter in forty-five pounds of meat, and it will make several gallons of soup. Its use is largely confined to the great cities, although it is rapidly gaining a foothold in the smaller towns. In many hospitals it has totally usurped the place of beef tea as a food for convalescents. Many exploring and camping parties have also used it with success, there being no more condensed form of food manufactured. The product of one factory alone amounts in value to more than \$1,000,000 every year, and it is growing rapidly. As yet the consumption of the Chicago output is confined largely to the United States and Canada.



PEPSIN AND ITS PRODUCTION

Everyone is familiar with the methods of repairing humanity with artificial legs, glass eyes, false teeth and wigs, but it may not be generally known that a factory at the stock yards in Chicago is busy all the

year round in making artificial digestions.

For it is the purpose of pepsin to relieve the man whose stomach has rebelled at harmful methods of eating. After each meal he simply takes a little tablet of the digestion, which he carries in a convenient vest pocket, swallows it, and forthwith forgets—in theory at least—his troubles. Anyone will admit that this is a charming arrangement.

In health, manufactured pepsin is not necessary, because the stomach furnishes its own supply. There are millions of little cells that have no other duty than to furnish the ferment, and when the food comes down they eject the supply which they have been saving up, and by its peculiar properties the marvelous process of digestion goes forward. But if a man overworks his stomach by eating too much or too often, or by going to work too soon after eating, the cells grow tired, and finally fall sick, and cannot perform the task set for them. To remedy this difficulty, some inventive genius conceived the idea, about ten years ago, of taking the pepsin from the stomachs of hogs and concentrating it into a convenient form of use. Since that time the process, which was then confined to the chemical laboratory and was conducted on an exceedingly narrow basis, has assumed the proportions of an industry, and thousands of persons are using the product. There are even varieties of chewing gum which are said to contain pepsin in small quantities.

No one knows just what pepsin is. It has never been isolated from the cells of the stomach, and no chemist has ever been able to analyze it. It is to the stomach what magnetism is to the magnet. The United

States pharmacopeia defines it as follows:

"Pepsinum (Pepsin): A proteolytic ferment, or enzyme, obtained from the glandular layer of fresh stomachs from healthy pigs, and capable of digesting not less than 3,000 times its own weight of freshly coagulated and disintegrated egg albumen. A fine, white, or yellowish-white, amorphous powder, or thin pale yellow or yellowish, transparent or translucent grains or scales, free from any offensive odor, and having a mildly acidulous or slightly saline taste, usually followed by a suggestion of bitterness. It slowly attracts moisture when exposed to the air."

The whole process of making pepsin, many steps of which are secret, consists in the isolation of the ferment to as great a degree as possible, there being no way of getting it entirely separate from the cell walls of the stomach.

The laboratory in which it is made is located close to where 1,500,000 hogs are killed annually, and within an hour from the time the animal breathes its last, the part of its stomach (about the size of a man's hand) in which the pepsin can be found, is in the hands of skilful workmen. The pieces are placed at once in rows of crocks containing dilute hydrochloric acid, .002 per cent solution, where they are left all day long. They are then taken out, and the men put them through a secret chemical process to remove the peptone, or the product of the digestive action of the pepsin on the membranous parts of the stomach, with which it comes. It then goes to a vacuum pan, where, by a steady low heat, the moisture is partially removed, after which it is spread out on glass plates, where it dries down to thin, fine yellow scales, having a peculiar bril-

liant luster. Girls pack the product in bottles, and it is ready for shipment.

The market price is about 75 cents an ounce, and it takes ordinarily about 100 hogs' stomachs to make a pound of pepsin. Numerous tonics composed of wine and pepsin are also made at the factory.

From the stomachs of calves comes the extract of rennet which is also made at the laboratory and largely used in cheese-making. The process of manufacture is simple. The stomachs are chopped up in a sausage machine into fine bits, and macerated in a solution of salt and water. The material is then ready for packing and shipment. Because cheese contains so much of the digestive ferment—pepsin—it is said to "digest everything but itself." Perhaps this is the reason cheese goes with pie as the end of a meal.



STARCH AND HOW IT IS MADE

Starch has a greater diversity of uses, perhaps, than any other vegetable commodity. Here is a family at dinner with a guest or two who have come to spend the evening. Those tea biscuits which the servant has just brought in are light and flaky because the cook used baking powder in making them, and baking powder is more than one-third starch. The shirt bosoms of the men about the table glisten with a polish imparted by starch, and those delicate desserts are nothing but starch and water and flavoring. The heavy Brussels carpet on which the feet of the diners rest was fairly saturated with starch during the process of manufacture, and that is why it is now so firm and stiff. One of the girls wears a cotton waist. In making the cloth

the cotton fibers were "sized" again and again in starch, and the sewing thread used was treated in a similar manner. The dab of powder on the nose of the hostess is nothing but starch, and if she ever uses rouge or complexion preparations—of course she doesn't—they, too, are largely starch. Many of these candies, and they are the purest made, contain more or less starch—starch, possibly, that has been first made into artificial gum arabic.

The dinner over, the company moves to the library—a veritable starch realm. All the paper has been sized in starch, the pictures on the wall have been pasted with it, and the book-covers remain in place largely because of the starch used. Possibly, too, the wall paper is fastened on with starch. A young doctor in the party could tell wonderful stories about the part starch plays in *materia medica*, and how important it is in the preparation of splints and surgical bandages. And there are a great many other less important uses.

The quantities used are something enormous. The annual production in this country is 500,000,000 pounds of corn starch, 2,000,000 pounds of wheat starch and 30,000,000 pounds of potato starch. Of these the most expensive is wheat starch, which is used largely in very fine laundry work. The largest consumers of starch are the makers of cotton and linen goods, and of carpets. Besides these familiar kinds of starch there are tapioca, from manioc-root; arrow-root, from the *macanta*, and sago, the pith of a species of palm. A kind of starch is also made from the horsechestnut, but the quantities manufactured are small.

Although starch-making is a simple process it was not understood until within the last century. When the corn first comes

into the factory, it is taken to a big room filled with vats in which it is placed after all the readily removable dust has been blown away. Warm water is poured over the mass, and changed from time to time for three days. The corn is then soft and pulpy.

It next goes to the grinding mill, composed of buhr-stones, like those used in old-fashioned flour-mills. Here it is pulverized and washed at the same time, by a stream of water which is kept passing always over the stones. The water carries off the pulverized mass to long screens made of bolting cloth, where it spreads out and is further washed by means of pipe sprays above. All the starch that will go through the sieve cloth is caught below and the husks and germs of the corn remain above. This refuse matter makes very excellent feed for cattle, it being rich in oil and nitrogenous matter.

The "starch milk" is now run out on numerous low tables set at an incline. Being insoluble in cold water it quickly precipitates, the water running off. It is now dug up and washed repeatedly in agitator tanks, to get out the gluten and other impurities. Water is the most important factor in starch-making, for unless starch can be washed scores of times it is valueless.

When it has reached the required degree of purity it is packed in wooden molds which are perforated and lined with fine cloth, thus allowing the water to escape. The blocks come out in masses about six by eight inches in size, and they are taken at once to the dry-room, where they are submitted to a high temperature.

The heat not only dries them out, but draws out other impurities which form in a crust on the outside. This crust varies

from one-fourth to one-half an inch in thickness, and is scraped off by boys and girls, the scraping being washed. Then the blocks are wrapped in paper and sent to the low temperature drying-room, where the heat breaks them up into the familiar irregular crystals. The starch is now ready for shipment. Certain laundry starches are treated with an alkali before being placed on the market and cooking starch is passed through a pulverizer. Corn will yield from twenty-four to twenty-eight pounds of starch to the bushel. Wheat starch is made exactly like corn starch.

Of late years potato starch has become very popular. It is easily made, the potatoes being simply ground and submitted to a series of washings. Since the sand lands in northern Wisconsin and Minnesota began to be used extensively for potato growing, numerous starch factories have sprung up and great quantities are produced. Being so near the source of supply the work can be done very cheaply. Ordinary American potatoes yield only about eight pounds of starch to the bushel, while German potatoes yield twelve pounds. The department of agriculture has, however, found a potato that will grow in Utah and will produce as much starch as the German variety.



GLUCOSE AND HOW IT IS MADE

Glucose is connected in the minds of many people with all that is bad. Some think it is made from dead horses; others believe that it comes from glue, and most of them are sure that it destroys the lining of the stomach. The fact is, glucose is a sugar, resembling cane and beet sugar in many of its properties, but it is not quite

so sweet. It is perfectly harmless, and can be used to advantage as a substitute for the more expensive sugars in preserving fruits, and also making candies, jellies, syrups and like purposes.

A great deal of it is used in the manufacture of wines and beers, for glucose can be converted into alcohol by fermentation. Glucose can be made from any substance containing starch, and practically all of the glucose turned out of this country is made from corn. In Europe potatoes are used as a source of glucose. A bushel of corn yields about forty pounds of glucose.

Corn can be converted directly into glucose; that is to say, it can be ground without preliminary treatment, and then boiled with water and acid until the starch is entirely converted into glucose. But this process is attended by so many drawbacks that most manufacturers prefer to use the longer but more satisfactory process of separating the starch from the remaining constituents of corn, and then using the starch so obtained for making the glucose.

The first step in this process is the "steeping" of the corn. Large wooden tanks are used for this purpose, and from 2,000 to 3,000 bushels of corn are run into one of these tanks and covered with water. The temperature of the water is kept at nearly 80 degrees Fahrenheit during the whole steeping stage. The fumes of burning sulphur, known to chemists as "sulphur dioxide," are blown into the tank from below, and in this way the water and corn become strongly saturated with sulphurous acid.

The object of the steeping process is to soften the corn so that it can be easily ground, and to dissolve the gummy substance which binds together the starch and

the gluten. From one to three days are required to properly steep the corn. Then the "steep" water is run into the sewer, the corn is washed with fresh water, a door in the bottom of the tank is opened, and the corn is taken by a screw conveyor to the mill.

There the corn is ground, either between millstones or rollers. If a grain of corn is examined, it will be found that on the pointed end of the grain is a soft, pliable mass which can be easily removed from the starchy part of the grain with a penknife. This soft part is the "germ," and if this germ is pressed between the fingers it will exude an oily substance, for there is about 50 per cent of oil, known as "corn oil," in the germ.

It is valuable as a salad oil, and is used in the making of toilet soaps and in mixing paints. By an ingenious mechanical process the germs are separated from the starchy matter by some of the more enterprising manufacturers. This is done by crushing the corn, before it is thoroughly ground, by running it between corrugated rolls. The crushed corn is then run into a tub of starchy water, which is stirred mechanically.

The germs are much lighter than the starch, and float on the surface of the water, and are carried off through an exit pipe, whose mouth is just below the surface of the water in the tub. The germs are then washed on a gently moving sieve which retains the germs but permits the starchy water to run through.

The germs are freed from the greater part of the water they contain by rotation in a centrifugal machine. They are then dried in hot air, ground, and shaped into cakes; the cakes are put into a power-

ful hydraulic press, where they are subjected to a heavy pressure, and the oil runs out in a steady stream and is collected in a tank. The cakes that remain are a rich food for cattle, and are known commercially as "oil cake," which is worth from \$10 to \$20 a ton. Most of it is exported to Europe.

The starchy mass left after the germs have been extracted is now ground until all of it has disappeared. The glucose makers recognize four substances in corn—starch, gluten, oil and bran. The germs contain nearly all of the oil and a large part of the gluten, and they carry with them some of the bran. It is now necessary to separate the remaining bran and gluten from the starch.

The ground material is run into a tank and mixed with water until it has the necessary consistency, and it is then forced in a powerful stream on to a mechanical sieve, known as a shaker in glucose factories. The shaker is a frame about eight feet long and three feet wide, covered with fine bolting cloth. It is inclined at an angle of 30 degrees to the horizontal, and in order that the corn may move along it in a steady stream, flowing into the screen at the upper end and dropping off at the lower end, the screen is kept in constant vibration, a suitable mechanism causing it to move back and forth. Numerous jets of water play about the screen at different points. In this way the fine particles of starch and gluten are washed away from the bran, which drops off from the end of the screen and is carried away. The bran is either sold as wet feed, or is dried for shipment as dry feed.

At this point there is left a yellowish milky mash containing starch and gluten,

and the manufacturer takes advantage of this fact to separate them. The milky liquid is allowed to run over slightly inclined tables, about 200 feet long. The heavy starch settles near the head of the tables in great quantities, and in less quantities throughout the length of the tables. A large factory will have perhaps one hundred of these tables. The gluten floats away with the water and runs through a pipe at the end of the tables into large settling tanks.

Here it is allowed to settle for a day or two; the water, which is almost clear, is run into the sewer. The gluten that is left in the tanks still contains a large amount of water; most of this is removed by forcing it into a filter press, which retains the gluten and allows the water to escape. The press consists of a series of grooved iron plates with a central orifice; cloths are placed between the plates in such a manner that the solid gluten cannot pass the cloths, but must remain between them and the plates, while the water escapes through the pores of the cloth and leaves the press by a suitable opening. The liquid enters the press by the central orifice. After the spaces between the plates have become filled with gluten the pressure is removed by means of a screw, and the cakes of gluten are removed after separating the plates.

The gluten is thoroughly dried by means of hot-air or steam driers; it is then placed in bags and is ready for the market. It is a gray or yellowish coarse flour, and sells for \$20 a ton. It is valuable as a cattle food.

Having now got rid of all his by-products, the manufacturer can proceed at once to the preparation of glucose. The starch

is well mixed with water in a tank, and is then pumped into the converters, where it is mixed with about twenty-five pounds of muriatic or sulphuric acid. The converter is a large copper boiler, into which live steam is introduced by means of a perforated pipe. The starch is heated in the converter for about an hour at a pressure of thirty to forty pounds. The heating is entirely done with steam. The conversion is finished when a simple chemical test shows that no more starch is present.

The action in the converter is nothing but a chemical change from starch into glucose, or grape sugar, as it is sometimes called. A fair sized converter will convert 750 pounds of starch at a time to glucose, the yield of glucose being in the neighborhood of 1,000 pounds. After conversion is complete, the operator opens a valve and allows the glucose to enter the neutralizing tank. The glucose, as it enters the neutralizer, is a yellowish-brown liquid, containing about 30 per cent solid matter.

The acid which was added to the starch is still present in the glucose, and the next operation is the addition of a neutralizing agent. If muriatic acid was used for converting, soda is used for neutralizing, but if sulphuric acid was used, marble dust is used for the latter purpose. The workman must be careful to add the exact amount of soda or marble dust required to effect neutralization, for a perfectly neutral product is desired. After the goods are neutralized, some solid matter separates; it is removed by filtration through filter presses, or sometimes by filtration through long canvas bags.

The weak solution of glucose is known as "bag liquor," or "press liquor," at this stage. It must now be clarified, which is

effected by passing it over filters of bone coal. These filters are iron tanks twenty feet high, and filled with animal charcoal or bone coal. Animal charcoal possesses the wonderful property of absorbing matter from sugar solutions, and absorbs only a small amount of sugar.

The bag liquor is allowed to percolate through this filter, and comes off the coal looking perfectly clean. After a certain amount of liquor has passed over the coal it becomes saturated with impurities, which are then removed by washing with acid and burning in a kiln. The liquor from the coal is known as "light liquor;" it contains 65 to 70 per cent of water, and most of this must now be removed by evaporation. If a solution of sugar or of glucose be heated in the air it will soon turn brown, owing to oxidation or burning. So, in evaporating a solution of glucose, resort is had to a vacuum evaporator.

Water will boil at a much lower temperature in a vacuum than in air, and therefore the evaporation of a saccharine liquor can be conducted in a vacuum without danger of charring. Ordinarily a system of three evaporators is used together. This is called a triple-effect system, and by using it all the waste steam is utilized. The evaporation is continued in the triple-effect system until the liquor contains about 60 per cent of sugar. It is now filtered over bone coal to remove any remaining color, and is then boiled in a vacuum pan—a large copper boiler heated by means of a steam coil and connected with a vacuum pump—until it has reached the desired degree of concentration.

The operator takes off a sample through a valve when nearing the end of the boiling, and determines its density or gravity by

means of a hydrometer spindle. Glucose comes on the market in different grades, according to the gravity. Mixing glucose has a gravity of 41 degrees Beaume; confectioners' glucose 42, 43, and 44 degrees Beaume as desired. The boiling is stopped whenever the desired gravity is acquired. The finished glucose is run off into tanks and is shipped in barrels when ordered.

Glucose is a thick syrup. It should be perfectly clear and colorless, and if properly made will not leave an after taste in the mouth. By some few changes in the method of converting and boiling, a solid crystalline product can be obtained called "grape sugar." Grape sugar is used for making beer and wines.

There are only about half a dozen glucose factories in operation in this country. The smallest of them grinds 10,000 bushels of corn a day; the largest 30,000. Most of the glucose produced finds its way into candy and syrup.



ROCK CANDY AND HOW IT IS MADE

Rock candy is the purest confection made. It is simply large crystals of sugar beaded on strings, and when it is not colored it has nothing in it but sugar, and the best sugar in the market at that.

Time was when every school-boy in the country knew the taste of rock candy, and carried it around in his pockets, but the caramels, gum-drops, Turkish pastes, nutgats, chocolate creams and other forms of the mushy candy, which, the dentists say, is ruining the teeth of the rising generation, have shoved the old-fashioned rock candy to one side, and the crunch of strong

white teeth on the hard crystals is seldom heard. Large quantities of it are still made, however, and, in fact, the output increases from year to year, for liquor dealers, druggists and patent medicine manufacturers consume tons of the strung sweet. A well-known dentist is authority for the statement that if molasses candy, rock candy and hard bread were eaten by boys and girls instead of paste candies and soft bread the next generation of dentists would have little to do. It requires strong teeth to break up rock candy in the mouth, for the crystals are glazed, hard and smooth-surfaced.

The manufacturer of rock candy begins with refined granulated sugar of the best quality. Brown or soft white sugar will not do; he must start with crystals. He first empties between four and five barrels of sugar into a copper boiler, which is five feet in diameter and between three and four feet deep. After the sugar has been dumped in, from sixteen to twenty gallons of water are mixed with it, and then the steam is turned into the coil of pipes on the bottom and around the sides of the pan. After half an hour's boiling the sugar has changed into a clear, thick syrup, and it is drawn off through a pipe in the bottom of the pan, through fine sieves, into copper pots beneath.

In these copper pots, each of which is about two feet in diameter at the top and a foot in diameter at the bottom, the syrup crystallizes into rock candy. The copper pots have little holes in the sides, and through these holes cotton cords are run, so that the pot from the bottom up is strung with the strings, which are placed in the pots before the syrup is poured in. They are fastened in the holes with plaster, which

not only holds the cords in place, but closes up the holes, so that the hot syrup cannot leak out. Each pot holds about five gallons of syrup and weighs about forty pounds, and after they are filled to the top with the boiling syrup, they are carried to the hot house and left there for a time.

The hot house is usually made entirely of brick, with strong shelves on all sides. Under the shelves the steam pipe which heats the house is coiled, and in this hot house the pots, with their sweet contents, are left for two or three days in a temperature of about 160 degrees. The heat causes the syrup to crystallize, and the crystals arrange themselves on the cotton strings and the side of the pot, forming a cover of crystals for the copper pot. When the three days are up, the pots are taken down from the shelves and the thin crust of crystals is smashed in. Then the clear syrup, which is used in saloons and at soda-water fountains, is drained off. Clear water is dashed into the pot to wash the syrup from the rock candy. Then the pots are turned upside-down over a trough, and left there for a day in a temperature of 70 degrees, while the remainder of the syrup drains off and the rock candy becomes glossy and hard. The plaster of paris is scraped from the sides of the copper crystallizing pots, thus releasing the strings, so that when the pots are thumped down upon a table and rapped with a mallet the rock candy falls upon the board and is broken up and weighed out into five-pound and forty-pound boxes.

Yellow rock candy is often colored with burnt sugar, and this is the only disagreeable feature in the making of rock candy. The sugar is burned in shallow copper pans, which are placed directly over the blaze of a hot fire. About 100 pounds of sugar and

four gallons of water are mixed together in the pans. In a short time the syrup begins to burn, and a thick, irritating smudge rises from the sugar and compels the workmen to cover their mouths and noses with cloth or wear respirators, for they are obliged to stand over the pans and stir the contents. In a short time the sugar is burned to a crisp and then it is washed with water, pounded, and run through a sieve. The red rock candy is colored with carmine and is the only rock candy made which has anything in it but sugar.



COMMON FOOD ADULTERATIONS

So much is heard about food adulteration, adulterations of dairy products, adulterated spices, and so forth, that many people believe the whole story is a tissue of falsehoods, got up by those who delight in springing sensations upon the credulous public. As a matter of fact, however, 15 per cent of our food materials is adulterated in one way or another, and the figures to prove this assertion are obtained from the United States department of agriculture and many state boards of health. It is such a simple matter for one who knows anything about food materials to mix with them some comparatively cheaper and worthless material, that it is not surprising that unscrupulous dealers and manufacturers resort to this extensive practice.

Everyone is familiar with the milk dealers' frequent practice of adding water to the lacteal fluid. Milk is slightly heavier than water; that is to say, a pint of milk weighs more than a pint of water, or, as a chemist would say, the specific gravity of milk is greater than that of water. Large

consumers of milk frequently use a simple instrument called a lactometer to determine the specific gravity of milk. If the milk has been watered the lactometer readily shows that it is lighter. But the milkman can easily deceive them on that score. Taking advantage of the fact that cream is lighter than milk, he removes some of the cream and adds water until the lactometer shows the proper gravity for the milk. As cream has a yellowish cast, its removal causes the milk to become bluish in color, so the skillful manipulator adds some coloring material to conceal this defect.

Sometimes they add boracic acid or salicylic acid as a preservative to keep the milk from souring. Chemical tests show that all of these practices are resorted to, and it is found that the amount of adulteration is very great where dealers are not subjected to careful supervision, and where rigorous laws against adulterations are not enforced.

Coffee is one of the most commonly adulterated food materials. Sometimes inferior or damaged coffees are subjected to a course of treatment in order to imitate superior grades. It is not an unusual practice to take one of the green coffees from South America and expose it to a moist, high temperature to produce a brown color and thus sell it for Java. Other means have been resorted to for producing coffee of any desired shade, such as the use of pigments. The following substances have been used in this country for coloring coffee: Chrome yellow, Venetian red, yellow ochre, burnt umber, charcoal and French black.

Another method that has been used for "improving" raw coffees is to wash with water, decolorize by treatment with lime water, wash again, dry rapidly, and then roast until the desired color has been ob-

tained. The weight that is lost in the process is restored by steaming, and then the beans are coated with glycerine, palm oil or vaseline. Coffee can be polished by rotation in cylinders with soapstone, or by covering with starch paste or syrup before roasting.

Ground coffees are easily adulterated. Out of thirty samples tested by the department of agriculture, twenty-six were found to contain adulterations; the most common adulterant was chicory, but wheat, peas, barley and even bread were found in some of the samples. Some of them contained only 25 per cent of coffee. The chicory used for this purpose is the ground root of the chicory plant, known to botanists as the "*cichorium intybus*."

A simple test for the presence of chicory is to throw some of the suspected coffee into a dish of cold water. Chicory sinks rapidly, coloring the water, and soon becomes soft, whereas coffee floats on top and does not color the water. Artificial coffee beans have been made by some misapplied genius. Flour is mixed with some chicory, and occasionally a little coffee, and is then pressed into the shape of coffee beans and roasted until the desired shade is produced. Artificial coffee beans are very hard; in attempting to break or grind such coffee its spurious nature becomes manifest.

Canned vegetables are not usually adulterated in the general sense of the term, but they often contain substances which are injurious from a hygienic standpoint. Canned foods were first introduced into Europe in the early part of the century. The food was placed in a tin can, water was added, and then a lid with a small aperture in the center was soldered on. The can was placed in boiling water and its con-

tents were allowed to boil briskly for some time, and then the hole was closed with a drop of solder.

At the time the process was introduced it was supposed that its efficacy was due to the expulsion of the air from the can; but modern science shows that it is due to the killing of the germs or spores that cause decay when present and alive. Goods canned in this way become soft and mushy, and lose their attractive appearance because of the prolonged boiling.

So the canners looked about for some means to overcome this difficulty. One of the principal improvements, from the canner's point of view, was the use of copper vessels for boiling peas and beans. Imperfectly cleaned copper vessels soon become coated with copper salts, and these dissolve in water and give a deep green color to the vegetables cooked therein. The observant ones soon found that the same effect could be produced by adding copper or zinc salts. Nearly all French peas and beans contain copper, but American products generally are free from it. The amount of copper contained in a can of the most highly colored peas is not large, and a small amount of copper used occasionally will not seriously injure the health of the consumer.

In order to dispense with the long boiling required for effectively killing the germs and spores, canners use antiseptics. For this purpose they add a minute amount of salicylic acid or boric acid to the contents of the can, and then boil the contents a few minutes before sealing. There is a difference of opinion as to whether the use of preservatives in minute quantities is prejudicial to health.

There are three types of baking powder on the market—tartrate powders, phos-

phate powders and alum powders. All baking powders contain bicarbonate of soda, or baking soda, as it is called by the housewife. In theory a baking powder must contain bicarbonate of soda mixed with some substance that will set free carbonic-acid gas when dissolved in water, and that powder which contains the greatest amount of gas, other things being equal, is the best powder.

The carbonic-acid gas thus generated permeates the mass of dough with which it is mixed and causes it to rise. If that were the only point involved in passing on the merits of baking powder, the solution of the question would be an easy one. But it so happens that the chemicals used in the manufacture of the powder do not entirely disappear as gas, but the greater portion of them remain in the bread in the form of salts, and it is claimed that some of these salts are injurious to health.

Of the various powders used, the phosphate gives off the greater amount of gas, averaging 14.5 per cent; next comes the tartrates, averaging 11.6 per cent gas, and the alum powders contain about 10 per cent gas. There is a class of mixed alum and phosphate powders which give off about 9 per cent of gas; some of them, however, yield as high as 11 per cent. Nearly all of the phosphate and tartrate powders are of high value, but some few of the alum powders are inferior in leavening power, owing to a deficiency of bicarbonate of soda and an excess of starch.



BAKING POWDER, PURE AND ADULTERATED

Baking powder is probably more extensively advertised than any other food commodity in the market, and yet half a cen-

tury ago it was practically unknown. When the old-time housewife wished to make a pan of biscuit or cake she took a pinch of cream of tartar and a pinch of baking soda, the size of the pinch in each case being a culinary secret passed down from generation to generation, and mixed them with the flour. Not infrequently a "dash" of sour milk took the place of the cream of tartar, especially if the housewife had gained a reputation for "milk-risin'" biscuits. A "dash" was the same indefinite nature as the "pinch," and only genius at cookery ventured to use it.

If the cakes came out all right it was a lucky bake, but if they were sodden and tough or sour and soapy in taste, it was always the flour that was bad, or the eggs were not fresh, or the oven was not hot enough. When the housewife offered excuses at the table she never thought to blame the "pinches" of cream of tartar and soda, or the "dash" of sour milk. But there was where the trouble probably lay.

Sometimes the proportion of chalk to the cream of tartar was unusually large, and how was a poor cook, even though she possessed every mark of genius, to tell how much she used? Besides this, the baking soda varied in strength and purity in a similar way.

To relieve this distressing state of affairs, and to provide better biscuits and cakes, the baking powder manufactory sprung up into existence. Here the cream of tartar and soda were mixed according to exact chemical formulas, and even the bride of a fortnight may now make cakes without ever having been instructed in the mysteries of the "pinch" and the "dash." Of course there are a great many adulterated baking powders—any one who reads the advertise-

ments of the rival companies will be convinced of it—but there are a few manufacturers who really make the pure compound of cream of tartar and soda, with a little starch added as the “body.”

Baking powder rises on exactly the same principle as that on which gunpowder explodes. It is composed of an acid (cream of tartar) and an alkali (soda), combined while bone dry, so that no chemical combination takes place. The moment water is added, however, the two substances unite with effervescence, and throw off carbonic acid gas, which permeates the dough and blows it full of bubbles just like little balloons. In baking, the sides of these little bubbles harden and the cake is said to be light. In the same way the ingredients of gunpowder unite and throw off carbonic acid gas, and it, too, makes things rise, but at a somewhat more rapid rate than in the case of baking powder.

If for any reason dough is not well mixed, or the gas escapes from the baking powder without blowing up the bubbles, then the cake is “heavy”—in company with the spirits of the cook.

The manufacture of baking powder has grown to be a great industry. There is one manufacturer in Chicago who alone turns out 50,000 cans every working day in the week, and he had stored in his factory recently twenty car-loads of one-pound cans. A car-load is 1,500 dozen, or 18,000 cans, and in twenty of them there would be 360,000 cans. Each can is six inches long, and the whole number, if placed end to end, would reach 180,000 feet, or about thirty-four miles. Chicago alone uses between 2,000,000 and 3,000,000 pounds of baking powder yearly. Each pound will make about 700 biscuits, thus placing the biscuit

consuming capacity of Chicago at 1,400,000,000. Besides this, Chicago is a great distributing center for baking powder. It supplies immense quantities to the western states and exports a considerable amount to foreign countries.

The acid originally used in baking powder is cream of tartar. This is exported from France, Italy and Spain, in the form of lees of wine and argals, both of which are by-products of the manufacture of wine. As every one knows, wine when first expressed from the grapes is not suitable for use. It must “age.” As it stands in the French wine-cellars, a fine substance settles out of it and forms in the bottom of the butt. When the wine is drawn off this may be hardened to a pinkish mass known as lees of wine. It contains about 25 per cent of cream of tartar. If the wine is allowed to stand longer, the argals begin to crystallize out on the sides of the butt, in a thin, hard coating. When crumbled off they are a deep purple in color, and somewhat resemble calspar. About 80 per cent of them is pure cream of tartar, the other 20 per cent being made of impurities, mainly lime. Formerly the lees were sold for fertilizers and the argals were burned for lamp-black, but since the baking-powder industry began to grow, the demand for both has equaled and even exceeded the supply.

Both products are brought to this country in big wooden casks. After being crushed to a fine powder at the refinery, they are boiled in huge copper tanks for some hours. The solution is then allowed to cool slowly, and the cream of tartar crystallizes on the sides of the tank, the lime and other impurities remaining in the solution or being cast to the bottom in the form

of a precipitate. Workmen scrape off the crystals, which have assumed a faded brown color, and they are redissolved and discolored by passing through a filter of animal coal. The crystals resulting from a second cooling of the solution are white and about 99 per cent pure. In this form it is ready for use in the baking-powder manufactory.

The center of everything at the factory is the little chemical laboratory. As soon as the casks containing the crystals of cream of tartar and the barrels of soda and starch reach the factory, a sample of each is analyzed to see if it is exactly what it purports to be. The process begins on the top floor of a building, in a wide, low room, which bears a strong resemblance to a flour mill. The atmosphere is heavy with flying particles of cream of tartar, and the visitor who doesn't understand how to breathe that kind of air passes from one sneezing convulsion into another. But the workmen have grown accustomed to having a perpetual sour taste in their mouths, and they rather like it. The crystals of cream of tartar are fed into a hopper of a grinding machine which much resembles an old-fashioned flour mill, and when it comes out it is a fine, white powder. It is then sifted through a number of bolting screens, after the manner of flour, and from time to time it is tested to see that the grinding has been complete. Now the cream of tartar is barreled and placed inside of a little pen in one corner of the room, the soda and starch occupying other little pens not far away. All these ingredients are pure white in color, finely pulverized, and great care must be taken not to get them mixed up. At one end of the room there are three trap doors in the floor, over the first of which the words "Cream of Tartar" are printed in big brass

letters, over the second, "Soda," and over the third, "Starch." The workman takes each ingredient from its pen and dumps a few barrellfuls down into bins below. Everything is kept scrupulously clean.

Underneath the third floor the bins narrow to funnels, the mouths of which are covered with draw slides. Under each spout there is a weighing scale over which runs a truck track which continues all around over two traps in the floor. The trucks are most ingeniously constructed. At one side there is a little wooden box set on a pivot. When the truck is under the cream of tartar spout the box is filled with just the proper amount, according to the scale on which the truck rests, and it is then tipped on the pivot until it empties into the body of the truck. Then the truck is trundled along to the next spout and the proper amount of soda is allowed to run from the bin spout into the box, which is in turn dumped, and the same process is repeated with the starch.

The truck now contains a full "charge," the ingredients being mixed according to a secret formula. Starch is added as a "filler" to separate the particles of the cream of tartar and the soda, thus helping to preserve the powder by preventing a chemical combination until the water is added.

The "charge" being allowed to run through the spout in the bottom of the truck, it passes to the second floor into a long cylinder somewhat like a steam boiler. Then the cylinder begins to whirl, thoroughly mixing the ingredients. At the cylinder end there is a box covered with canvas, and strongly resembling a voting booth. When the charge is mixed a truck is run into this booth, and the baking-powder fills it. The trucks hold 400 pounds, and a sample

from each is placed in a snuff box and sent to the laboratory for analysis. Great pains are taken to see that everything is exactly right.

Now the powder goes to a row of pretty girls, in triangular paper caps, to be boxed and labeled. Each of the tin boxes is filled by weight with exactly the right amount of powder, and the work is done with great deftness and rapidity. Heaped around them on every side are cords and cords of cans, ready to go to the shipping department.

Alum and alum-ammonia are extensively used as the acid element, in place of cream of tartar, for adulterating baking powder. They are much less expensive, but their use is beginning to come under the ban of the law. Various states of the Union have pure food laws that prohibit the use of either. Germany and other European countries are vigorous in their prohibition of the use of these adulterants.

To detect ammonia in baking powder, mix one heaping teaspoonful with one teaspoonful of water in a tin-cup; boil thoroughly for a few moments, stir to prevent burning, and if ammonia is present you can smell it in the rising steam; or place a can of the suspected powder, top down, on a hot stove for a minute or two, then take off the cover and smell.

Alum powder can be tested by putting two teaspoonfuls of the powder in a glass of cold water. If no effervescence takes place, alum powder is present.



ADULTERATION IN ALCOHOLIC LIQUORS

Distillers are not entirely responsible for all the mysterious compounds which are sold under the name of bourbon and rye

whiskies, cognac, brandy, rum, absinthe, etc. The man who tackles "John Barley-corn" would not smack his lips so complacently if he knew half of the acids, alkalies and other chemicals he is sending down his throat. He might object to swallowing acetate of potassium, sulphuric acid, blue vitriol, ammonia, or other similar stuff, alone or mixed, but he revels in blissful ignorance, and drinks compounds which carry those identical ingredients. It is frequently said by those who think they know, that pure whisky, pure brandy and pure rum will hurt no one, but a congressional investigation of the tricks and secrets of compounders disclosed the fact that many of the best-known and high-priced brands of whisky and brandy contained but a small percentage of the genuine stuff.

Alcoholic liquors are made from the materials containing starch and sugar in sufficient quantities, by fermentation. If, after fermentation, the liquor is subjected to distillation, it is called distilled liquor, and to this class belong whisky, brandy, rum, absinthe, etc. Brandy is made from fermented grape juice. The best grades of cognac brandy are made from white French wines; inferior qualities are made from Spanish and Portuguese wines. Whisky is made from the fermented extract of rye, barley, or corn. In Scotland or Ireland malted barley is used, sometimes alone, sometimes mixed with other grains. Bourbon whisky is made from rye and malted corn. Gin is produced by mixing common spirits with juniper berries. Frequently other materials are used for flavoring, such as cardamon seed and oil of fennel. Liqueurs are made from brandy and alcohol by flavoring them with aromatic substances, such as orange peel, absinthe and anise;

then the flavored liquid is distilled, and after distillation it is colored with caramel and sweetened in most cases.

The manufacture of whisky will serve as a type for the manufacture of other spirituous liquors. The first step in the process is the saccharifying of the grain—that is, changing the starch into sugar. The grain is mixed with malt and ground in a suitable mill, and then run into the mash tub, where it is agitated with water at a temperature of 150 degrees Fahrenheit. The mashing process is continued until the starch is entirely changed into malt sugar or maltose. This requires from one to five hours, according to the amount of grain in the mash. Malt contains a substance called “diastase,” which possesses the remarkable property of changing starch into maltose or malt sugar. It is for this reason that malt is added to the grain in the mash tub.

Starch is changed by prolonged boiling into dextrin, which does not ferment readily, while maltose ferments very easily. Great care therefore is taken during the mashing process to reduce the dextrin formation to the minimum. This is done by keeping the temperature near 145 degrees Fahrenheit during the whole process. The liquor obtained in the mash tub is called the “wort.” When the wort is as strong as possible it is drained off and the grain is treated with a fresh supply of water, and the wort so obtained is added to the first. The wort on coming from the mash tub must be cooled rapidly, otherwise an acid fermentation will set in which produces vinegar, and the presence of such a substance is undesirable.

The wort is cooled by allowing it to trickle over the cold pipes, which are kept at a low temperature by some system of

artificial refrigeration similar to that used for making ice. About five hours are required to reduce the contents of a mash tub to a temperature of 60 degrees. The wort is now ready for fermentation. Fresh brewer’s yeast or softened compressed yeast is added to the liquid, which is stored in wooden tanks in the cellar of the distillery. One gallon of brewer’s yeast or one-half pound of compressed yeast is used for every 100 gallons of wort.

In the early stages of the fermentation the yeast cells grow without producing much alcohol. Later the malt sugar ferments and alcohol is formed; the dextrin gradually is changed to maltose, and this is then changed to alcohol by fermentation.

During the fermentation the temperature gradually rises because of the chemical changes taking place. The temperature should be kept near 93 degrees Fahrenheit in order to get the best results. Fermentation is complete when no more alcohol forms, and this takes from five to nine days. The yeast is skimmed off, and the fermented wort at once is subjected to distillation. The object of distillation is to increase the percentage of alcohol in the liquor, and at the same time to remove undesirable substances from it. The undistilled liquid contains alcohol, water, solid matter, fusel oil and other substances.

Alcohol boils at 172 degrees, water at 212 and fusel oil boils, some at 207 and some at higher temperatures. If a mixture of such liquids be boiled and the resulting vapors cooled, the process is called distillation. If the liquid which distills over and is condensed be collected in different portions or fractions, the first fraction will contain a larger percentage of alcohol than the original liquid, for the alcohol distills off

at the lower temperature. The remaining fractions will contain more water and fusel oil. The first portion will not contain all of the alcohol, nor will it be entirely free from water and fusel oil, but if it is redistilled the percentage of alcohol will be greatly increased and the amount of water and fusel oil will be correspondingly diminished.

The old stills were based on this principle, and many such stills are used to-day in Scotland and Ireland. These consist of large, flat-bottomed vessels of copper set in brick work and heated underneath by direct firing. The still is connected at the top with a long spiral pipe called a "worm," which passes through a tank of cold water, where the alcohol vapors are cooled and the distillate is collected at the other end of the worm in a suitable tank. This method of distilling is wasteful of fuel, and for that reason a number of devices have been introduced for reducing the cost of the product and improving the quality.

The improved stills are somewhat complicated in construction, and they are continuous in action; that is, the liquor to be rectified is fed in a steady stream without interruption to the process, and the rectified spirits are drawn off continuously. A standard still consists of two columns made of wood, copper lined, called respectively the "analyzer" and the "rectifier." The analyzer is divided into a number of compartments by perforated copper plates, supplied with valves opening upward. Small pipes pass through each plate, projecting about half an inch above each plate and reaching down into small copper pans placed on the plate below. From the analyzer the vapors enter the rectifier, which also is divided into compartments

by perforated plates until near the top of the column, which is free from plates, and where the finished spirit is held back and carried away to the condensing worm.

The liquor to be rectified is pumped through a zigzag pipe which circulates through the rectifier. When it reaches the bottom of the rectifier it is entirely changed to vapor. The vapor then goes to the analyzer, which is heated by steam from below. The water condenses and runs off at the bottom of the analyzer; the vapors of the alcohol pass into the rectifier, where they circulate through the compartments, and as they ascend they are almost entirely freed from the water and fusel oil. The vapor then passes through a condensing worm, where it is thoroughly cooled and liquefied, running into storage tanks.

Not all distilled liquors are made this way. Some require to be heated by direct firing in order to develop certain peculiar flavors. Large quantities of spirituous liquors are made, however, from spirits destitute of flavor by blending with them suitable flavoring extracts and substances. The skillful compounder will take some high-wines or spirits, mix with them a small amount of genuine whisky, add a few drops of essential oils, put in some sugar color, and bottling the mixture, will paste on the bottle a label bearing the name of some well-known brand of whisky.

A great deal depends upon the flavoring matter, and each compounder has his secret mixture which produces his particular brand of whisky. Prune juice is a favorite flavor with compounders and a mixture of extract of tea and currants is used for rye whisky. In order to give an artificial "bead" to inferior liquors they are treated with a beading oil made from oil of bitter

almonds by a simple chemical treatment. Bourbon whisky sometimes is made by adding an oil which consists largely of fusel oil which has been treated with acetate of potassium, sulphuric acid, blue vitriol, ammonium oxalate and black oxide of manganese. "Scotch" whiskies are made by adding to a small quantity of real Scotch whisky, oil of birch and spirits. Cognac is made from spirits by flavoring with cocoanut oil and coloring with burnt sugar, and there are other tricks in the whisky trade too deep and mysterious to be penetrated by one outside of the inner circle.



TOILET PREPARATIONS FROM THE TROPICS

Americans and Europeans draw on the Orient and the tropics for a very wide range of supplies. Not only do tea, coffee and spices, rare woods and silks, and queer art trinkets and treasures come from far away, but some other things less conspicuous but still not to be ignored. We know what value the brown natives of the Pacific and Indian oceans place upon the palm tree in its various forms, how they obtain from it not only shelter and fuel but actually food and drink as well. We ourselves likewise owe our gratitude to the palm tree for many favors. Familiar enough are sago from one variety, cocoanuts from another, and fans from a third. The areca palm or betel-nut palm is another which contributes to our comfort, though we are hardly as well informed about it. This tree is one of the most beautiful of all the palm species, and in the Malay archipelago and the peninsulas of India and Burma, where it flourishes, attains a height of eighty feet.

The nuts themselves grow in crowded bunches or clusters, each nut about the size of a hen's egg. The cover is a hard and glossy rind, sometimes almost like mahogany in its polish and hardness. Next inside



ARECA-NUT, FRUIT OF THE BETEL-PALM.

comes an albuminous mass, and then in the center is a large seed-like kernel which when cracked yields a nut-like substance. From the contents the natives make their favorite chewing compound, which they much prefer to tobacco. Bits of the betel-

nut are mixed in the proper proportion with lime, and a morsel of the mixture is wrapped in a small leaf. This entire combination is placed in the mouth and chewed. The results are very repugnant to a traveler who is not used to such things. The saliva produced is of a bright red color like blood, and it is expectorated constantly during the chewing process. The lips of habitual betel-nut chewers crack and bleed, and their teeth become blackened and loosened from the gums, but in spite of that they stick to the offensive habit faithfully.

The American and European use of the betel-nut is fortunately a wiser one. The nuts are shipped to us in great quantities, having been picked by the natives who have whole forests of them growing wild at their disposal. They are bought by druggists and manufacturers of toilet preparations, and are converted into drugs and into tooth powders and pastes. The medical use of them is as a vermifuge. Of course the substance of the nut is modified by mixture with other things when made into tooth powder, so that it cleanses and whitens the teeth instead of blackening them, as it does for the Malays of the Indian ocean.

The cocoanut palm provides us with its delicious nuts, to eat in their natural form or after preparation as puddings and pies. In addition to this use, however, the half-dried nuts are shipped to this country in great quantity as "copra," to be made into cocoanut butter, soaps and cosmetics.



AMERICAN PROGRESS IN TWENTY YEARS

One of the most fascinating official bulletins ever issued by the government made

its appearance in the annual report of the bureau of statistics of the Treasury Department in August, 1902. It is entitled "Progress of the United States in its area, population and material industries." The story it tells is perhaps the most marvelous to be found in the history of all the nations. It shows in compact tabular form the development of the United States to a great and wealthy nation, all the material facts being arranged by decades, beginning with 1800 and ending with 1900. Of course any comparison of the end of the century conditions with those found at the beginning of the century would show a development from almost nothing to the great American empire of to-day.

Of far greater importance and interest is the growth of the United States during the last twenty years. Probably no other nation ever made such rapid strides as the United States has made since 1880. The official figures which measure this growth are simply amazing. Remember that the period under consideration is only twenty years, a trifle in the life of a nation. At the beginning of this period the United States was already one of the greatest nations. Its population had swept across the continent. It had recovered from the disaster of the civil war. It had enjoyed years of large crops and uninterrupted prosperity. Yet the development since that time reads almost like a fairy story rather than a tale culled from the sober figures of census and other official statistics.

Since 1880 the population of the United States has increased by 50 per cent.

The aggregate wealth of the country, "the true valuation of real and personal property," has more than doubled—from \$42,000,000,000 to \$94,000,000,000.

Wealth per capita has increased 50 per cent—from \$850 to \$1,236.

The public debt, less cash in the treasury, has decreased nearly one-half—from \$1,919,000,000 to \$1,107,000,000.

The debt per capita has dropped from \$38.27 to \$14.52.

The annual interest charge has diminished more than one-half—from \$80,000,000 a year to \$33,500,000, and per capita from \$1.59 to 44 cents.

The amount of gold coined has increased more than 50 per cent—from \$62,000,000 a year to \$99,000,000.

The amount of gold in circulation has nearly trebled—from \$225,000,000 to \$611,000,000.

The amount of silver in circulation has more than doubled—\$69,000,000, as compared with \$142,000,000.

The total circulation of money has more than doubled—\$973,000,000, compared with \$2,055,000,000. Circulation per capita has increased only 50 per cent—\$19.41 compared with \$26.93.

The number of national banks has nearly doubled—2,056 compared with 3,606.

Deposits in national banks have well-nigh trebled—\$1,006,000,000 compared with \$2,625,000,000.

Deposits in savings banks have almost exactly trebled—\$819,000,000 to \$2,450,000,000.

The number of depositors in savings banks has increased from 2,235,000 to 6,108,000.

That the farmers of the country have shared in this wonderful increase of wealth is clearly shown by further comparisons of 1880 with 1900.

The value of farms and farm property has grown from \$12,000,000,000 to \$20,-

500,000,000, an increase of 70 per cent.

The value of the yearly products of farms has increased from \$2,212,000,000 to \$3,764,000,000.

The value of farm animals has increased from \$1,882,000,000 to \$2,982,000,000.

The number of manufacturing establishments in the United States has doubled—from 253,000 to 513,000.

The value of the output of these establishments has increased two and one-half times, from \$5,369,000,000 to more than \$13,000,000,000.

The number of employes in these establishments has more than doubled—2,732,000 to 5,719,000. The wages of these employes have almost trebled—\$948,000,000 to \$2,735,000,000.

Exports of merchandise have increased more than 50 per cent. Exports of agricultural products have increased more than 25 per cent. Exports of manufactures have more than quadrupled.

Imports of all merchandise have increased 30 per cent, but imports per capita have fallen from \$12.51 to \$10.88.

The production of gold has more than doubled—from \$36,000,000 a year to \$79,000,000.

The production of silver has nearly doubled—\$39,000,000 compared with \$74,500,000.

The production of coal has almost quadrupled—64,000,000 tons compared with 241,000,000.

The production of petroleum has nearly trebled—1,100,000,000 gallons compared with 2,661,000,000.

The production of pig iron has nearly quadrupled.

The production of steel has multiplied eight times—1,247,000 tons to 10,188,000.

Prices on steel rails have fallen from \$67.50 per ton to \$32.29.

The production of copper has increased tenfold—27,000 tons to 270,000.

The production of wool has increased 25 per cent, of wheat 5 per cent, of corn 40 per cent, of cotton 65 per cent, of sugar 60 per cent.

The consumption of sugar has more than doubled—957,000 tons to 2,219,000.

Cotton taken by American mills has doubled, and cotton exported has increased 75 per cent.

Miles of railway in operation have more than doubled—93,262 miles compared with 194,321.

The number of passenger cars has more than doubled—12,788, against 26,786. The number of freight cars has increased two and one-half times—544,000 to 1,358,000.

Tonnage of American vessels built has more than doubled, tonnage engaged in foreign trade has diminished 40 per cent, tonnage engaged in domestic trade has increased 60 per cent and tonnage on the great lakes has multiplied two and one-half times.

Tonnage passing through the Sault Ste. Marie Canal has multiplied seven times.

Freight rates on wheat, Chicago to New York, have fallen from 12.27 cents per bushel to 4.42, lake and canal; from 15.7 cents to 5.05, lake and rail, and from 19.9 cents to 9.98, all rail.

Freight rates per ton mile on all the railways of the United States have dropped from 1.30 cents to 0.75 cents.

The receipts of the federal government have increased from \$333,000,000 to \$567,000,000.

The number of postoffices in the United

States have increased from 44,000 to 77,000.

The receipts of the Postoffice Department have trebled.

The number of telegraphic messages sent in the United States has more than doubled—29,000,000,000 to 63,000,000,000.

The number of newspapers and periodicals published has more than doubled—9,273 to 20,806.

Salaries paid in public schools have more than doubled—\$60,000,000 to \$136,000,000.

The number of patents issued has almost doubled—14,000 per year to 26,500.



THE PRINCIPAL PLANETS

PLANETS.	Mean Distances from the Sun in Miles.	Mean Diameters in Miles.	Length of Year in Days.	Length of Days in	
				Hours	Minutes.
Vulcan	13,082,000	.....	24	..	..
Mercury	35,392,000	2,900	88	24	5
Venus	66,131,500	7,510	225	23	21
The Earth..	91,430,220	7,913	365	23	56
Mars	139,312,200	4,920	687	24	37
Jupiter	475,693,100	88,390	4,333	9	56
Saturn	872,134,600	71,900	10,759	10	29
Uranus	1,753,851,000	33,000	30,647	9	30
Neptune ...	2,746,271,200	36,000	60,127	..	..

Jupiter has four moons; Saturn has eight moons and a ring; Uranus has six moons; Neptune has one moon.

Our moon is 2,160 miles in diameter, and is distant 238,650 miles from our earth.

The sun is about 815,000 miles in diameter.

The planets known to the ancients were Mercury, Venus, Mars, Jupiter and Saturn.

The nearest fixed star to our solar system is Cygni No. 61, and this is 210,000,000 times more distant from the sun than we are, or about 20,000,000,000,000,000 miles.

STRENGTH OF VARIOUS SUBSTANCES

With fifty-four inches between supports, a rod of cast iron, one inch square, will break under a load of 550 pounds.

A cube of cast iron, one inch each way, will be crushed under a pressure of 90 tons.

A bar of cast iron, one inch square, will break under a tensile strain of $9\frac{1}{2}$ tons.

These figures show the capacity of best material. Very inferior iron would probably have not over one-half the above resisting power.

The actual cohesive force of different substances is as below, the size of the rod tested being in each case one inch square, and the number of pounds showing the actual breaking strain:

	Lbs.		Lbs.
Hard steel.....	150,000	Locust wood.....	20,000
Soft steel.....	120,000	Cast iron	19,000
Best Swedish iron	84,000	Oak wood.....	17,000
Ordinary bar iron	70,000	Ivory	16,000
Silver	41,000	Elm wood	13,000
Copper	35,000	Ash wood.....	12,000
Gold	22,000	Horn	8,750
Whalebone	7,500	Pitch pine wood..	7,500
Bone	5,750	Poplar wood.....	5,500
Tin	5,500	Cedar wood.....	4,800
Zinc	2,600	Lead	860



THE AVERAGE VELOCITIES OF VARIOUS BODIES

A man walks 3 miles per hour or 4 feet per second.

A horse trots 7 miles per hour or 10 feet per second.

A horse runs 20 miles per hour or 29 feet per second.

Steamboat runs 20 miles per hour or 29 feet per second.

Sailing vessel runs 10 miles per hour or 14 feet per second.

Rapid rivers flow 3 miles per hour or 4 feet per second.

A moderate wind blows 7 miles per hour or 10 feet per second.

A storm moves 36 miles per hour or 52 feet per second.

A hurricane moves 80 miles per hour or 117 feet per second.

A rifle ball moves 1,000 miles per hour or 1,466 feet per second.

Sound moves 743 miles per hour or 1,142 feet per second.

Light moves 192,000 miles per second.

Electricity moves 288,000 miles per second.



HOW TO MIX PAINT FOR TINTS

For brown, mix red and black.

For rose, mix lake and white.

For chestnut, mix white and brown.

For purple, mix white, blue and lake.

For pearl, mix blue and lead color.

For pink, mix white and carmine.

For silver gray, mix indigo and lamp-black.

For lead color, mix white and lamp-black.

For chocolate, mix black and venetian red.

For bright green, mix white and green.

For French white, mix purple and white.

For dark green, mix light green and black.

For pea green, mix white and green.

For brilliant green, mix white and emerald green.

For orange, mix red and yellow.

For pearl gray, mix white, blue and black.

For flesh color, mix white, lake and vermilion.

For drab, mix umber, white and venetian.

For cream, mix white, yellow and venetian.

For olive, mix red, blue and black.

For buff, mix yellow, white and a little venetian.



UNITED STATES POSTAL REGULATIONS

FIRST-CLASS MAIL MATTER.—*Letters.*—This class includes letters, and anything of which the postmaster cannot ascertain the contents without destroying the wrapper, or anything unsealed which may be wholly or partly in writing—except manuscript for publication accompanied by proof sheets. Postage, two cents each ounce or for each fraction above an ounce. On local or drop letters, at free delivery offices, two cents. At offices where no free delivery by carriers, one cent. Registration fee 8 cents in addition to regular postage.

SECOND-CLASS.—*Regular Publications.*—This class includes all newspapers, periodicals, or matter exclusively in print and regularly issued at stated periods from a known office of publication or news agency. Postage, one cent a pound or fraction thereof, when mailed by the publisher; when mailed by others, one cent for four ounces and every additional fraction thereof.

THIRD CLASS.—*Miscellaneous Printed Matter.*—Mailable matter of third class includes printed books, circulars or other matter wholly in print (not of the second class), proof sheets and manuscript accompanying the same and postage shall be paid at the rate of one cent for each two ounces or fractional part thereof, and shall

fully be prepaid by postage stamps affixed to said matter.

All packages of matter of the third class must be so wrapped or enveloped that their contents may be readily and thoroughly examined by postmasters without destroying the wrappers.

FOURTH CLASS.—*Merchandise Samples, etc.*—Mailable matter of the fourth class includes all matter not embraced in the first, second or third classes, which is not in its form or nature liable to destroy, deface or otherwise damage the contents of the mailbag, or harm the person of any one engaged in the postal service.

All matter of the fourth class is subject to a postage charge at the rate of one cent an ounce or fraction thereof, except seeds, roots, cuttings, bulbs and the like, on which the rate is one cent for two ounces, and all must be fully prepaid.

POSTAL CARDS.—Postal cards are sold at a fixed rate of one cent (and two cents for foreign) each, in any quantity. Unclaimed postal cards are never returned to the writer. Anything pasted on or attached to a postal card subjects it to letter postage.

MONEY ORDERS.—Domestic orders are sold at the following rates: Not exceeding \$2.50, 3 cents; not exceeding \$5, 5 cents; not exceeding \$10, 8 cents; not exceeding \$20, 10 cents; not exceeding \$30, 12 cents; not exceeding \$40, 15 cents; not exceeding \$50, 18 cents; not exceeding \$60, 20 cents; not exceeding \$75, 25 cents; not exceeding \$100, 30 cents.

REGISTRY FEE on domestic or foreign letters and packages, in addition to fully prepaid postage, is 8 cents.

FOREIGN POSTAGE.—Rates to Canada and Mexico are the same as in the United States. To all other countries in the Postal

Union, letters 5 cents for each half ounce,
printed matter 1 cent for each 2 ounces.



CENTER OF POPULATION IN THE
UNITED STATES

The manner in which settlement has pro-
gressed westward is graphically shown by
the census returns, which indicate every
ten years the actual center of our national
population. There is surprisingly little va-
riation in the line of advance, either north
or south, showing that emigration generally
follows parallels of latitude instead of mak-
ing radical changes of climate. The cen-
ter of population at various dates has been
as follows:

	Westward Movement
1790. 23 miles east of Baltimore, Md.	
1800. 18 miles west of Baltimore, Md....	41 miles
1810. 40 miles northwest of Washington, D. C.....	36 miles
1820. 16 miles north of Woodstock, Va..	50 miles
1830. 19 miles southwest of Moorefield, W. Va.....	39 miles
1840. 16 miles south of Clarksburg, W. Va.	55 miles
1850. 23 miles southeast of Parkersburg, W. Va.....	55 miles
1860. 20 miles south of Chillicothe, O...	81 miles
1870. 48 miles northeast of Cincinnati, O.	42 miles
1880. 8 miles southwest of Cincinnati, O.	58 miles
1890. 20 miles east of Columbus, Ind....	48 miles
1900. 6 miles southeast of Columbus, Ind.	14 miles



PUBLIC LANDS IN THE UNITED
STATES

FROM THE STATEMENT OF THE DE-
PARTMENT OF THE INTERIOR.

	Surveyed.	Unsurveyed.	Total.
Alabama	359,250		359,250
Alaska		359,492,760	359,492,760
Arizona	10,886,745	39,400,241	50,286,986
Arkansas ...	3,493,444		3,493,444
California ..	34,423 923	8,043,589	42,467,512
Colorado ...	35,134,613	4,515,634	39,650,247

	Surveyed.	Unsurveyed.	Total.
Florida	1,438,749	157,662	1,596,411
Idaho	11,722,541	31,564,153	43,286,694
Kansas	1,196,900		1,196,900
Louisiana...	377,206	65,018	442,224
Michigan ...	430,483		430,483
Minnesota ..	2,386,295	2,309,908	4,696,203
Mississippi ..	285,804		285,804
Missouri ...	337,946		337,946
Montana	18,546,146	49,416,911	67,963 057
Nebraska ...	9,798,688		9,798,688
Nevada	29,622,658	31 654,848	61,277,507
N. Mexico...	41,951,628	14,589,542	56,541,170
N. Dakota...	12 597 130	6,128,109	18,725,239
Oklahoma ..	5,733,572		5,733,572
Oregon	23,489,861	10,888,046	34 377,907
S. Dakota...	11,612,943	317,866	11,930 809
Utah	10,019,262	32,948,189	42 967,451
Washington	5,237,302	5,888,581	11 125,883
Wisconsin ..	313,565		313,565
Wyoming ..	43,194,311	5,163,858	48,358,169
Grand Total	314,509,965	602,544,915	917,135,880

Excluding Alaska there is in the United
States alone, wholly unoccupied land, more
than half of which is good for cultivation
or grazing, amounting in extent to about
one-fourth the entire area.



NATIONAL PARK RESERVES IN
THE UNITED STATES

	Date of Reservation.	Area Acres.
California, Yosemite Nation- al Park.....	Oct. 1, 1890	967,680
Sequoia National Park..	Sept. 25, 1890	161,280
General Grant National Park.....		2,560
Washington, Mount Rainier National Park.....	Mar. 2, 1899	207,360
Wyoming, Yellowstone Na- tional Park.....	Mar. 1, 1872	2,142,720
Maryland, Antietam Nation- al Military Park.....	Aug. 30, 1890	
Mississippi, Vicksburg Na- tional Military Park..	Feb. 21, 1899	
Pennsylvania, Gettysburg National Military Park.	Feb. 11, 1895	
Tennessee, Chickamauga and Chattanooga National Military Park	Aug. 19, 1890	
Shiloh National Military Park	Dec. 27, 1894	
Arkansas, Hot Springs of Garland County...	1832, 1877, 1880	912
Arizona, Casa Grande Ruin	June 22, 1892	480

GRAIN PRODUCTION OF UNITED STATES IN BUSHELS

	Indian Corn.	Wheat.
1890	1,489,970,000	339,262,000
1895	2,151,138,580	467,102,947
1900	2,105,102,516	522,229,505

	Oats.	Barley.	Rye.
1890	532,621,000	67,168,344	25,807,472
1895	824,443,537	87,072,744	27,210,070
1900	809,125,989	58,925,833	23,995,927

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NUMBER OF FARM ANIMALS IN THE UNITED STATES

	Horses.	Mules.	Sheep.
1890	14,213,837	2,331,027	44,336,072
1893	16,206,802	2,331,128	47,273,553
1896	15,124,057	2,278,946	38,298,783
1900	13,537,524	2,086,027	41,883,005

	Swine.	Milk Cows.	Beeves.
1890	51,602,780	15,952,883	36,849,024
1893	46,094,807	16,424,087	35,954,196
1896	42,842,759	16,137,586	32,085,409
1900	38,321,547	16,292,360	27,610,054

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NUMBER OF FARM ANIMALS IN THE VARIOUS STATES, 1901

States and Territories.	Horses.	Mules.	Milch cows.
Maine	111,987	.....	197,878
N. Hampshire ..	55,028	.....	136,825
Vermont ...	84,812	.....	271,602
Massach'ts .	63,478	.....	179,791
Rhode Island	10,281	.....	25,511
Connecticut .	43,682	.....	143,098
New York...	596,738	4,421	1,458,251
New Jersey.	79,180	7,269	214,674
Pennsylvania	548,747	37,053	924,260
Delaware ..	30,883	4,928	35,376
Maryland...	129,662	12,638	155,022
Virginia	233,940	35,998	244,937
N. Carolina..	146,697	111,398	248,263
S. Carolina..	66,979	97,357	126,762
Georgia	110,266	158,594	297,324
Florida	37,673	8,354	114,251
Alabama ...	132,224	129,726	254,727
Mississippi .	201,477	163,082	256,951
Louisiana ..	143,593	90,904	125,747
Texas	1,137,015	265,880	700,802
Arkansas ...	234,596	145,504	196,808
Tennessee ..	317,601	151,265	254,675
W. Virginia.	151,847	7,412	163,895
Kentucky ..	365,602	106,547	248,208
Ohio	653,499	17,228	736,735
Michigan ...	410,410	2,646	459,107

States and Territories.	Horses.	Mules	Milch cows.
Indiana	601,271	41,650	611,975
Illinois	1,003,299	82,225	1,001,212
Wisconsin ..	409,822	4,754	895,822
Minnesota ..	455,122	8,416	646,673
Iowa	981,352	31,547	1,250,775
Missouri ...	762,734	183,362	673,195
Kansas	734,881	79,410	680,457
Nebraska ...	652,284	43,016	628,750
S. Dakota...	290,746	6,693	372,321
N. Dakota ..	175,137	7,036	171,073
Montana	164,923	924	43,994
Wyoming ...	72,258	1,514	18,140
Colorado ...	146,687	8,667	91,666
N. Mexico ..	83,351	3,472	19,317
Arizona ...	50,414	1,041	18,404
Utah	68,295	1,599	57,787
Nevada	44,305	1,384	18,069
Idaho	128,077	917	31,500
Washington	169,694	1,441	115,485
Oregon	185,844	5,609	116,581
California ..	342,265	52,915	318,425
Oklahoma ..	42,649	8,407	37,014
Total ...	13,665,307	2,134,213	15,990,115

States and Territories.	Other cattle.	Sheep.	Swine.
Maine	109,440	246,628	75,306
N. Hampshire...	79,380	78,289	56,104
Vermont	133,788	165,940	76,208
Massachusetts ..	74,875	40,437	54,846
Rhode Island ...	10,356	10,715	13,722
Connecticut	66,588	31,745	54,165
New York.....	561,077	841,955	645,237
New Jersey	41,558	42,299	151,120
Pennsylvania ...	528,942	790,604	1,043,331
Delaware	22,995	12,981	50,556
Maryland	105,900	136,135	331,853
Virginia	338,542	369,227	917,550
North Carolina..	295,530	261,400	1,369,703
South Carolina..	141,509	66,540	1,041,462
Georgia	423,018	327,584	2,093,987
Florida	325,774	83,598	429,128
Alabama	336,479	193,033	1,866,640
Mississippi	304,118	239,720	1,957,399
Louisiana	182,690	119,163	796,498
Texas	4,533,897	2,543,917	2,684,987
Arkansas	250,528	119,733	1,280,120
Tennessee	322,293	286,063	1,570,154
West Virginia...	243,460	440,014	331,563
Kentucky	341,181	597,643	1,357,765
Ohio	636,433	2,730,471	2,307,051
Michigan	341,535	1,396,053	735,035
Indiana	641,913	674,532	1,340,231
Illinois	1,265,066	613,191	2,008,265
Wisconsin	589,315	722,967	929,763
Minnesota	570,165	410,998	411,353
Iowa	2,163,584	613,343	3,408,281
Missouri	1,460,647	616,102	2,949,818
Kansas	2,076,489	231,192	1,591,341
Nebraska	1,395,829	292,779	1,353,671
South Dakota...	449,362	363,697	145,469
North Dakota...	252,640	359,721	111,959
Montana	952,598	3,377,547	42,265
Wyoming	694,973	2,328,025	22,345

States and Territories.	Other cattle.	Sheep.	Swine.
Colorado	973,259	1,655,551	20,713
New Mexico.....	701,967	3,128,692	30,204
Arizona	381,812	1,014,287	23,286
Utah	303,116	2,116,949	47,808
Nevada	224,317	576,994	10,441
Idaho	384,056	2,311,880	75,718
Washington	265,376	759,824	156,748
Oregon	573,646	2,575,468	216,430
California	664,704	2,175,545	374,141
Oklahoma	257,505	22,982	89,891
Total.....	27,994,225	39,114,453	38,651,631



HOGS PACKED AND MARKETING,
YEAR ENDING MARCH 1,
1901

Cities.	Number of Hogs.
Chicago	7,268,515
Kansas City	2,981,288
Omaha	2,241,599
St. Louis	1,566,550
Indianapolis	1,185,600
Cincinnati	617,031
Milwaukee and Cudahy.....	911,256
St. Joseph	1,723,377
Cedar Rapids	496,308
Ottumwa	653,785
Cleveland	500,785
Louisville	360,425
Sioux City	733,754
St. Paul	514,385
Nebraska City	114,962
Other Places West	1,731,053
Boston	1,370,000
Buffalo	343,000
Other Places East	1,046,000
Receipts at New York, Philadelphia, and Baltimore	2,620,000
Total 1901.....	28,980,000
Total 1900.....	28,172,000



WORLD'S PRODUCTION OF
WHEAT IN BUSHELS,
FOR 1901

United States.....	522,229,505
Russian Empire.....	458,084,000
France and Colonies (Algeria and Tunis)	338,383,000
Austria-Hungary	189,650,000
India	182,582,000
Germany	141,139,000
Italy	119,750,000
Spain	105,000,000

Argentina	101,266,000
British Isles	57,065,000
Rumania	56,463,000
Australasia	50,110,000
Turkey (European and Asiatic)....	50,000,000
Canada	44,542,000
Bulgaria	30,000,000
Japan	20,000,000
Persia	16,000,000
Mexico	15,000,000
Egypt	14,000,000
Belgium	12,000,000
Chile	12,000,000
Servia	10,000,000
Portugal	8,000,000
Uruguay	6,891,000
Rest of the World.....	25,869,495

Total World's Production.....2,586,025,000



THE WORLD'S PRODUCTION OF
WOOL IN 1901

Countries.	Pounds.
North America:	
United States.....	302,502,328
British Provinces.....	12,000,000
Mexico	5,000,000
Total	319,502,328
Central America and West Indies....	5,000,000
South America:	
Argentina	370,000,000
Brazil	1,500,000
Chile	7,500,000
Uruguay	96,000,000
Venezuela	15,000,000
All other South America.....	20,000,000
Total	510,000,000
Europe:	
Great Britain and Ireland.....	141,146,376
France	103,610,000
Spain	102,600,000
Portugal	13,410,000
Germany	49,590,000
Italy	21,451,000
Austria-Hungary	64,300,000
Russia, including Poland..	361,100,000
Sweden and Norway.....	8,200,000
Turkey and Balkan Peninsula.....	67,500,000
All other Europe.....	14,000,000
Total	946,907,376
Asia:	
Russia	60,000,000
Central Asia.....	46,000,000
British India.....	85,000,000

Asia—Continued	Pounds.
Asiatic Turkey.....	33,000,000
China	35,000,000
All other Asia.....	15,000,000
Total	274,000,000
Africa:	
Algeria and Tunis.....	30,425,000
Cape Colony, Natal, Orange Free State	100,000,000
Egypt	3,000,000
All other Africa.....	1,000,000
Total	134,425,000
Australasia	510,000,000
Oceanica	50,000
Grand Total.....	2,699,884,704



CANE AND BEET SUGAR OF THE WORLD

The following was the production of sugar in 1899-1900 by principal sugar-growing countries, in tons of 2,240 pounds:

Countries.	Cane Sugar.
Louisiana	132,000
Porto Rico.....	50,000
Cuba	395,000
British West Indies.....	134,000
Haiti and Santo Domingo.....	55,000
Peru	100,000
Brazil	175,000
Java	722,000
Hawaii	275,000
Queensland	122,500
Mauritius	155,000
British Guiana....	80,000
Argentina	90,000
Philippines	40,000
Beet Sugar.	
United States.....	72,944
Germany	1,790,000
Austria	1,120,000
France	970,000
Russia	900,000
Belgium	300,000
Holland	100,000



POUNDS PER BUSHEL

The following are minimum weights of certain articles of produce according to the laws of the United States:

	Per Bushel.
Wheat	60 lbs.
Corn, in the ear.....	70 "

	Per Bushel.
Corn, shelled	56 lbs.
Rye	56 "
Buckwheat	48 "
Barley	48 "
Oats	32 "
Peas	60 "
White Beans	60 "
Castor Beans	46 "
White Potatoes	60 "
Sweet Potatoes	55 "
Onions	57 "
Turnips	55 "
Dried Peaches	33 "
Dried Apples	26 "
Clover Seed	60 "
Flax Seed	56 "
Millet Seed	50 "
Hungarian Grass Seed	50 "
Timothy Seed	45 "
Blue Grass Seed	44 "
Hemp Seed	44 "
Corn Meal	48 "
Ground Peas	24 "
Malt	34 "
Bran	20 "

Salt.—Weight per bushel as adopted by different States ranges from 50 to 80 pounds. Coarse salt in Pennsylvania is reckoned at 80 pounds, and in Illinois at 50 pounds per bushel. Fine salt in Pennsylvania is reckoned at 62 pounds, in Kentucky and Illinois at 55 pounds per bushel.



COMPARATIVE YIELD OF VARIOUS KINDS OF VEGETABLES

(Productions in Pounds Weight per Acre.)

Vegetables.	Lbs. per acre.	Vegetables.	Lbs. per acre.
Hops	442	Grass	7,000
Wheat	1,260	Carrots	6,800
Barley	1,600	Potatoes	7,500
Oats	1,840	Apples	8,000
Peas	1,920	Turnips	8,420
Beans	2,000	Cinque-foil grass..	9,600
Plums	2,000	Vetches, green....	9,800
Cherries	2,000	Cabbages	10,900
Onions	2,800	Parsnips	11,200
Hay	4,000	Mangel Wurtzel..	22,000
Pears	5,000		

One acre will produce 224 lbs. mutton, 186 lbs. beef, 2,900 lbs. milk, 300 lbs. butter, and 200 lbs. cheese. A fair crop of potatoes from 16 bushels of seed is 340 bushels.



AGES TO WHICH ANIMALS LIVE

Animal.	Years.	Animal.	Years.
Whale	1,000	Tortoise	100
Elephant	400	Eagle	100
Swan	300	Raven	100

Animal.	Years.	Animal.	Years.
Camel	100	Swine	20
Lion	70	Wolf	20
Porpoise	30	Cat	15
Horse	20	Fox	15
Bear	20	Dog	10
Cow	20	Sheep	10
Deer	20	Rabbit	7
Rhinoceros	20	Squirrel	7



VALUE OF FOREIGN COINS,
(July 1, 1899)

Prepared by the Director of the Mint. G, Gold standard. S, Silver standard. G and S, Gold and Silver standard, generally at 15 1-2 or 16 to 1.

Countries.	Monetary Unit.	Value Oct. 1, 1898
Argentina, G. and S..	Peso	\$.96.5
Austria-Hungary, G...	Crown .....	.20.3
Belgium, G. and S....	Franc .....	.19.3
Bolivia, S.....	Boliviano .....	.44.3
Brazil, G.....	Milreis .....	.54.6
British Possessions, N.		
A.(except Newfound-		
land) G.....	Dollar	1.00.0
Central Am. States—		
Costa Rica, G.....	Colon .....	.44.3
Guatemala, Sal-)		
vador, Honduras, {	S..Peso .....	.44.3
Nicaragua		
Chile, G. and S.....	Peso .....	.36.5
	Amoy .....	.71.6
	Canton .....	.71.4
	Chefoo .....	.68.4
	Chin Kiang... ..	.69.9
	Fuchau .....	.66.2
China, S.....	Haikwan (cus-	
	toms) .....	.72.8
	Hankow .....	.67.0
	Niuchwang ..	.67.1
	Ningpo .....	.68.8
	Shanghai ....	.65.4
	Tientsin .....	.69.4
Colombia, S.....	Peso .....	.44.3
Cuba, G. and S.....	Peso .....	.92.6
Denmark, G.....	Crown .....	.26.8
Ecuador, S.....	Sucre .....	.44.3
Egypt, G.....	Pound,100 piasters.	4.94.3
Finland, G.....	Mark .....	.19.3
France, G. and S....	Franc .....	.19.3
German Empire, G....	Mark .....	.23.8
Great Britain, G.....	Pound sterling...	4.86.6½
Greece, G. and S.....	Drachma .....	.19.3
Haiti, G. and S.....	Gourde .....	.96.5
India, S.....	Rupée .....	.21.0
Italy, G. and S.....	Lira .....	.19.3
Japan, G. and S.....	Yen .....	.49.8
Liberia, G.....	Dollar	1.00.0
Mexico, S.....	Dollar .....	.48.1

Countries.	Monetary Unit.	Value Oct. 1, 1898
Netherlands, G. and S.	Florin .....	.40.2
Newfoundland, G.....	Dollar	1.01.4
Norway, G.....	Crown .....	.26.8
Persia, S.....	Kran .....	.08.2
Peru, S.....	Sol .....	.44.3
Portugal, G.....	Milreis	1.08.0
Russia, G. and S.....	Ruble.....	.51.5
Spain, G. and S.....	Peseta .....	.19.3
Sweden, G.....	Crown .....	.26.8
Switzerland, G. and S.	Franc .....	.19.3
Turkey, G.....	Piaster .....	.04.4
Uruguay, G.....	Peso	1.03.4
Venezuela, G. and S..	Bolivar .....	.19.3



AVERAGE OF WEALTH FOR
EACH INHABITANT

	Rural.	Urban.	Total.	Per-sonal
United Kingdom.	\$265	\$1,245	\$1,510	\$530
France	400	860	1,260	615
Germany	240	540	780	360
Russia	130	175	305	150
Italy	225	280	505	265
Denmark	575	575	1,150	620
Holland	305	610	915	435
Belgium	280	490	770	375
Switzerland	285	535	820	380
All Europe.....	180	470	695	320
United States....	295	875	1,170	555
Canada	300	680	980	365
Average for world	240	535	775	355



CONSUMPTION OF LIQUOR
THROUGHOUT THE
WORLD

(Figures represent the average consumption per capita.)

	Wine.	Beer.	Spirits.
United Kingdom.....	0.4	30.0	1.0
France	26.0	5.0	1.9
Germany	1.2	24.0	1.9
Russia	0.4	0.9	1.1
Austria	3.1	9.0	2.3
Italy	20.5	0.1	0.3
Spain	18.0	1.4	...
Scandinavia	0.2	9.5	2.0
Holland	0.4	10.5	2.0
Belgium	0.9	41.5	2.1
Switzerland	15.0	11.5	1.3
United States.....	0.3	12.8	1.1

ANNIVERSARIES

DATES OF HISTORICAL EVENTS CUSTOMARILY OR
OCCASIONALLY OBSERVED.

Jan. 1. Emancipation Proclamation by Lincoln, 1863.
Jan. 8. Battle of New Orleans, 1815.
Jan. 17. Franklin born, 1706.
Jan. 17. Battle of the Cowpens, S. C., 1781.
Jan. 18. Daniel Webster born, 1782.
Jan. 19. Robert E. Lee born, 1807.
Jan. 27. German Emperor born, 1859.
Feb. 12. Abraham Lincoln born, 1809.
Feb. 15. Battleship Maine blown up, 1898.
Feb. 22. George Washington born, 1732.
Feb. 22-23. Battle of Buena Vista, 1847.
March 5. Boston Massacre, 1770.
March 15. Andrew Jackson born, 1767.
March 18. Grover Cleveland born, 1837.
April 1. Bismarck born, 1815.
April 9. Lee surrendered at Appomattox, 1865.
April 12. Fort Sumter fired upon, 1861.
April 12. Henry Clay born, 1777.
April 13. Thomas Jefferson born, 1743.
April 14. Lincoln assassinated, 1865.
April 19. Primrose Day in England, Lord Beaconsfield died, 1881.
April 19. Battles of Lexington and Concord, 1775.
April 23. Shakespeare born, 1564.
April 27. General Grant born, 1822.
April 30. Washington was inaugurated first President, 1789.
May 1. Dewey destroyed the Spanish fleet at Manila, 1898.
May 13. First English settlement in America, at Jamestown, 1607.
May 13. The Society of the Cincinnati was organized by officers of the Revolutionary Army, 1783.
May 20. Mecklenburg, N. C., Declaration of Independence, 1775.
May 24. Queen Victoria born, 1819.
June 6. General Nathanael Greene born, 1742.
June 15. King John granted Magna Charta at Runnymede, 1215.
June 17. Battle of Bunker Hill, 1775.
June 18. Battle of Waterloo, 1815.
June 28. Battle of Fort Moultrie, Charleston, S. C., 1776.
July 1. Dominion Day in Canada.
July 1-2. General assault on Santiago de Cuba, 1898.
July 1-3. Battle of Gettysburg, 1863.
July 3. Cervera's fleet was destroyed off Santiago, 1898, by fleet under Admiral Schley.
July 4. Declaration of Independence, 1776.
July 14. The Bastille was destroyed, 1789.
July 16. Santiago surrendered, 1898.
July 21. Battle of Bull Run, 1861.
Aug. 13. Manila surrendered to the Americans, 1898.
Aug. 16. Battle of Bennington, Vt., 1777.
Sept. 1. Capitulation of Sedan, 1870.
Sept. 8. Battle of Eutaw Springs, S. C., 1781.
Sept. 10. Battle of Lake Erie, Perry's victory, 1813.

Sept. 11. Battle of Lake Champlain, McDonough's victory, 1814.
Sept. 13. Battle of Chapultepec, 1847.
Sept. 14. City of Mexico taken by the U.S. troops, 1847.
Sept. 17. Battle of Antietam, 1862.
Sept. 19-20. Battle of Chickamauga, 1863.
Sept. 20. Italians occupied Rome, 1870.
Oct. 7. Battle of King's Mountain, N. C., 1780.
Oct. 8-11. Great fire of Chicago, 1871.
Oct. 12. Columbus discovered America, 1492.
Oct. 17. Burgoyne surrendered at Saratoga, 1777.
Oct. 19. Cornwallis surrendered at Yorktown, 1781.
Nov. 5. Guy Fawkes Day in England. The Gunpowder Plot discovered, 1604.
Nov. 9. Great fire of Boston, 1872.
Nov. 10. Martin Luther born, 1483.
Nov. 25. British evacuated New York, 1783.
Dec. 2. Battle of Austerlitz, 1805.
Dec. 14. Washington died, 1799.
Dec. 16. Boston "Tea Party," 1773.
Dec. 16. The great fire in New York, 1835.
Dec. 22. Mayflower pilgrims landed at Plymouth Rock, 1620.
Dec. 25-26. Battle of Trenton, N. J., 1776.
Dec. 29. William Ewart Gladstone born, 1809.



TABLE OF MEMORABLE DATES

B. C.

1183 Fall of Troy.
1082 Era of the Great Pyramid.
878 Carthage founded.
776 Olympic Era began.
753 Foundation of Rome.
588 Jerusalem taken by Nebuchadnezzar.
536 Restoration of the Jews under Cyrus.
509 Expulsion of Tarquin from Rome.
480 Xerxes defeated Greeks at Thermopylæ.
55 Cæsar conquered Britain.
4 Birth of Jesus Christ.

A. D.

29 The Crucifixion.
70 Jerusalem was destroyed by Titus.
313 Constantine converted to Christianity.
410 The Romans abandoned Britain.
827 Egbert, first king of all England, Oct. 14.
1066 Battle of Hastings. Norman Conquest.
1096 The Crusades began.
1172 Ireland was conquered by Henry II.
1215 King John granted Magna Charta, June 15.
1265 First Representative Parliament in England.
1415 Battle of Agincourt, Oct. 25.
1431 Joan of Arc was burnt, May 30.
1453 Constantinople taken by the Turks.
1455 The Wars of the Roses began.
1462 The Bible was first printed at Mentz.
1471 Caxton set up his printing press.
1486 The feuds of York and Lancaster ended.
1492 Columbus discovered America, Oct. 12.
1517 The Reformation began in Germany.
1519 Cortez began the conquest of Mexico.
1535 The first English Bible printed.

A. D.

1539 Monasteries were closed in England.
 1558 Accession of Queen Elizabeth, Nov. 17.
 1565 Revolt of the Netherlands began.
 1572 The St. Bartholomew Massacre, Aug. 24.
 1588 The Spanish Armada defeated, July.
 1600 East India Company first chartered.
 1603 Union of England and Scotland, March 24.
 1605 The Gunpowder Plot in England.
 1607 Jamestown, Va., was settled.
 1609 Hudson River first explored.
 1616 Shakespeare died, April 23.
 1618 Thirty Years' War in Germany began
 1620 Pilgrims by the Mayflower landed.
 1623 Manhattan Island settled.
 1634 Maryland settled by Roman Catholics.
 1636 Rhode Island settled by Roger Williams.
 1640 Cromwell's Long Parliament assembled.
 1649 Charles I. was beheaded, Jan. 30.
 1653 Oliver Cromwell became Lord Protector.
 1660 Restoration of the Stuarts.
 1664 New York conquered from the Dutch.
 1664 The great plague of London.
 1666 The great fire of London began Sept. 2.
 1679 Habeas Corpus Act passed in England.
 1682 Pennsylvania settled by William Penn.
 1685 Revocation of the Edict of Nantes, Oct. 22.
 1688 James II. abdicated, Dec. 11.
 1690 Battle of the Boyne, July 1.
 1690 First newspaper in America; at Boston.
 1704 Gibraltar was taken by the English.
 1713 Peace of Utrecht, April 11.
 1714 Accession of House of Hanover, Aug. 1.
 1715 First Jacobite Rebellion in Great Britain.
 1720 South Sea Bubble.
 1745 Battle of Fontenoy, April 30.
 1745 Second Jacobite Rebellion in Great Britain.
 1756 Black Hole Suffocation in Calcutta.
 1757 Clive won Battle of Plassey in India.
 1759 Canada was taken from the French.
 1765 Stamp Act enacted.
 1773 Steam engine perfected by Watt.
 1773 Tea destroyed in Boston Harbor, Dec. 16.
 1775 Battle of Lexington, April 19.
 1775 Battle of Bunker Hill, June 17.
 1776 Declaration of Independence, July 4.
 1777 Burgoyne's surrender, Oct. 17.
 1779 Capt. Cook was killed, Feb. 14.
 1781 Cornwallis' surrender at Yorktown, Oct. 19.
 1788 First settlement in Australia, Jan. 26.
 1789 The French Revolution began July 14.
 1789 Washington inaugurated President, April 30.
 1793 Cotton gin invented by Whitney.
 1793 Louis XVI. of France executed, Jan. 21.
 1796 Vaccination discovered by Jenner.
 1798 The Irish Rebellion.
 1799 Battle of Seringapatam; death of Tippoo.
 1799 Bonaparte declared First Consul, Nov. 10.
 1801 Union of Great Britain and Ireland, Jan. 1.
 1803 Louisiana purchased from the French.
 1804 Bonaparte became Emperor of France.
 1805 Battle of Trafalgar, death of Nelson.
 1807 Fulton's first steamboat voyage.
 1812 Second war with Great Britain.
 1812 The French expedition to Moscow.
 1813 Perry's victory on Lake Erie, Sept. 10.
 1814 Scott's "Waverley" published.
 1815 Battle of New Orleans, Jan. 8.

A. D.

1815 Battle of Waterloo, June 18.
 1819 First steamship crossed the Atlantic.
 1820 Missouri Compromise adopted.
 1823 Monroe Doctrine declared, Dec. 2.
 1828 First passenger railroad in the United States.
 1830 Revolution in France, Orleanist succession.
 1832 South Carolina Nullification Ordinance.
 1835 Morse invented the telegraph.
 1835 Seminole War in Florida began.
 1837 Accession of Queen Victoria, June 20.
 1845 Texas annexed.
 1846 Sewing machine completed by Elias Howe.
 1846 The Irish Potato Famine.
 1846 British Corn laws repealed, June 26.
 1846 War with Mexico began.
 1848 French Revolution. Republic succeeded.
 1848 Gold discovered in California, Sept.
 1851 Gold discovered in Australia, Feb. 12.
 1851 First International Exhibition, London.
 1852 Louis Napoleon became Emperor, Dec. 2.
 1853 Crimean War began.
 1857 The Great Mutiny in India.
 1857 The Dred Scott decision.
 1859 John Brown's raid into Virginia.
 1860 South Carolina seceded, Dec. 20.
 1861 Emancipation of the Russian serfs.
 1863 Lincoln's Emancipation Proclamation, Jan. 1.
 1863 Battle of Gettysburg, July 1-3.
 1865 Lee surrendered at Appomattox, April 9.
 1865 President Lincoln assassinated, April 14.
 1866 Battle of Sadowa. Prussia beat Austria.
 1867 Emperor Maximilian of Mexico executed.
 1867 The Dominion of Canada established.
 1870 Franco-German War began, July 19.
 1870 Capitulation of French at Sedan, Sept. 1.
 1870 Rome became the capital of Italy.
 1871 The German Empire re-established.
 1871 The Irish Church was disestablished.
 1871 The great fire in Chicago, Oct. 8-11.
 1872 The great fire in Boston, Nov. 9.
 1876 Centennial Exposition at Philadelphia.
 1881 President Garfield shot.
 1882 British occupation of Egypt.
 1889 Brazil became a Republic.
 1893 World's Columbian Exposition at Chicago
 1894 Chinese-Japanese War began.
 1895 Cuban Revolution began, Feb. 20.
 1897 The Turkish-Greek War.
 1898 The Spanish-American War.
 1899 Universal Peace Conference.
 1899 The South African War.
 1901 President McKinley assassinated, Sept. 6.
 1902 Peace declared in South Africa.



MARRIAGE ANNIVERSARIES

End of first year, cotton wedding; second, paper; third, leather; fifth, wooden; seventh, woolen; ten, tin; twelve, silk; fifteen, crystal; twenty, china; twenty-five, silver; thirtieth, pearl; fortieth, rubies; fiftieth, golden; seventy-fifth, diamond.

THE STATES AND THE UNION

THE ELECTORAL VOTE IN 1904

THE THIRTEEN ORIGINAL STATES.

No.	States.	Ratified the Constitution.
1....	Delaware.....	Dec. 7, 1787
2....	Pennsylvania.....	Dec. 12, 1787
3....	New Jersey.....	Dec. 18, 1787
4....	Georgia.....	Jan. 2, 1788
5....	Connecticut.....	Jan. 9, 1788
6....	Massachusetts.....	Feb. 6, 1788
7....	Maryland.....	April 28, 1788
8....	South Carolina.....	May 23, 1788
9....	New Hampshire.....	June 21, 1788
10....	Virginia.....	June 26, 1788
11....	New York.....	July 26, 1788
12....	North Carolina.....	Nov. 21, 1789
13....	Rhode Island.....	May 29, 1790

STATES ADMITTED TO THE UNION.

No.	States.	Admitted.
1....	Vermont.....	March 4, 1791
2....	Kentucky.....	June 1, 1792
3....	Tennessee.....	June 1, 1796
4....	Ohio.....	Nov. 29, 1802
5....	Louisiana.....	April 30, 1812
6....	Indiana.....	Dec. 11, 1816
7....	Mississippi.....	Dec. 10, 1817
8....	Illinois.....	Dec. 3, 1818
9....	Alabama.....	Dec. 14, 1819
10....	Maine.....	March 15, 1820
11....	Missouri.....	Aug. 10, 1821
12....	Arkansas.....	June 15, 1836
13....	Michigan.....	Jan. 26, 1837
14....	Florida.....	March 3, 1845
15....	Texas.....	Dec. 29, 1845
16....	Iowa.....	Dec. 28, 1846
17....	Wisconsin.....	May 29, 1848
18....	California.....	Sept. 9, 1850
19....	Minnesota.....	May 11, 1858
20....	Oregon.....	Feb. 14, 1859
21....	Kansas.....	Jan. 29, 1861
22....	West Virginia.....	June 19, 1863
23....	Nevada.....	Oct. 31, 1864
24....	Nebraska.....	March 1, 1867
25....	Colorado.....	Aug. 1, 1876
26....	North Dakota.....	Nov. 2, 1889
27....	South Dakota.....	Nov. 2, 1889
28....	Montana.....	Nov. 8, 1889
29....	Washington.....	Nov. 11, 1889
30....	Idaho.....	July 3, 1890
31....	Wyoming.....	July 11, 1890
32....	Utah.....	Jan. 4, 1896

THE TERRITORIES.

Territory.	Organized.
New Mexico.....	Sept. 9, 1850
Arizona.....	Feb. 24, 1863
Indian.....	June 30, 1834
Oklahoma.....	May 2, 1890
District of Columbia.....	July 16, 1790
Alaska.....	July 27, 1868

The following is the electoral vote of the states as based upon the apportionment of 1900 :

States.	Electoral Votes.	States.	Electoral Votes.
Alabama.....	11	Nebraska.....	8
Arkansas.....	9	Nevada.....	3
California.....	10	N. Hampshire..	4
Colorado.....	5	New Jersey ...	12
Connecticut ...	7	New York.....	39
Delaware.....	3	North Carolina.	12
Florida.....	5	North Dakota..	4
Georgia.....	13	Ohio.....	23
Idaho.....	3	Oregon.....	4
Illinois.....	27	Pennsylvania .	34
Indiana.....	15	Rhode Island..	4
Iowa.....	13	South Carolina.	9
Kansas.....	10	South Dakota..	4
Kentucky.....	13	Tennessee.....	12
Louisiana.....	9	Texas.....	18
Maine.....	6	Utah.....	3
Maryland.....	8	Vermont.....	4
Massachusetts .	16	Virginia.....	12
Michigan.....	14	Washington ...	5
Minnesota.....	11	West Virginia.	7
Mississippi....	10	Wisconsin.....	13
Missouri.....	18	Wyoming.....	3
Montana.....	3		
		Total.....	476

Electoral votes necessary to a choice, 239.



THE CIVIL WAR OF 1861-65

NUMBER OF MEN IN THE UNION ARMY FURNISHED BY EACH STATE AND TERRITORY FROM APRIL 15, 1861, TO CLOSE OF WAR.

States and Territories.	Number of Men Fur-nished.	Aggregate Reduced to a Three Years' Standing.
Alabama.....	2,556	1,611
Arkansas.....	8,289	7,836
California.....	15,725	15,725
Colorado.....	4,903	3,697
Connecticut.....	55,864	50,623
Delaware.....	12,284	10,322
Florida.....	1,290	1,290
Illinois.....	259,092	214,133
Indiana.....	196,363	153,576
Iowa.....	76,242	68,630
Kansas.....	20,149	18,706
Kentucky.....	75,760	70,832
Louisiana.....	5,224	4,654
Maine.....	70,107	56,776
Maryland.....	46,638	41,275
Massachusetts.....	146,730	124,104

States and Territories.	Number of Men Furnished.	Aggregate Reduced to a Three Years' Standing.
Michigan.....	87,364	80,111
Minnesota.....	24,020	19,693
Mississippi.....	545	545
Missouri.....	109,111	86,530
Nebraska.....	3,157	2,175
Nevada.....	1,080	1,080
New Hampshire.....	33,937	30,849
New Jersey.....	76,814	57,908
New York.....	448,850	392,270
North Carolina.....	3,156	3,156
Ohio.....	313,180	240,514
Oregon.....	1,810	1,773
Pennsylvania.....	337,936	265,517
Rhode Island.....	23,236	17,866
Tennessee.....	31,092	26,394
Texas.....	1,965	1,632
Vermont.....	33,288	29,068
West Virginia.....	32,068	27,714
Wisconsin.....	91,327	79,260
Dakota.....	206	206
District of Columbia.....	16,534	1,506
Indian Territory.....	3,530	3,530
New Mexico.....	6,561	4,432
Washington.....	964	964
U. S. Colored Troops.....	93,441	91,789
Total.....	2,778,304	2,326,168

The number of casualties in the volunteer and regular armies of the United States, during the war of 1861-65, according to a statement prepared by the Adjutant-General's office, was as follows: Killed in battle, 67,058; died of wounds, 43,012; died of disease, 199,720; other causes, such as accidents, murder, Confederate prisons, etc., 40,154; total died, 349,944, total deserted, 199,105. Number of soldiers in the Confederate service who died of wounds or disease (partial statement), 133,821. Deserted (partial statement), 104,428. Number of United States troops captured during the war, 212,608; Confederate troops captured, 476,169. Number of United States troops paroled on the field, 16,431; Confederate troops paroled on the field, 248,599. Number of United States troops who died while prisoners, 30,156; Confederate troops who died while prisoners, 30,152.

WARS OF THE UNITED STATES

STATEMENT OF THE NUMBER OF UNITED STATES TROOPS ENGAGED.

War of the Revolution, from April 19, 1775, to April 11, 1783; regulars, 130,711; militia and volunteers, 164,080; Total, *309,781.

Northwestern Indian Wars, from Sept. 19, 1790, to Aug. 3, 1795; total, 8,983.

War with France, from July 9, 1798, to Sept. 30, 1800; total, †4,593.

War with Tripoli, from June 10, 1801, to June 4, 1805; total, ‡3,330.

Creek Indian War, from July 27, 1813, to Aug. 9, 1814; regulars, 600; militia and volunteers, 13,181; total, 13,781.

War of 1812 with Great Britain, from June 18, 1812, to Feb. 17, 1815; regulars, 85,000; militia and volunteers, 471,622; total, 576,622.

Seminole Indian War, from Nov. 20, 1817, to Oct. 21, 1818; regulars, 1,000; militia and volunteers, 6,911; total, 7,911.

Black Hawk Indian War, from April 21, 1831, to Sept. 31, 1832; regulars, 1,339; militia and volunteers, 5,126; total, 6,465.

Cherokee disturbance or removal, from 1836 to 1837; militia and volunteers, 9,494; total, 9,494.

Creek Indian War or disturbance, from May 5, 1836, to Sept. 30, 1837; regulars, 935; militia and volunteers, 12,483; total, 13,418.

Florida Indian War, from Dec. 23, 1835, to Aug. 14, 1843; regulars, 11,169; militia and volunteers, 29,953; total, 41,122.

Aroostook disturbance, from 1836, to 1839; militia and volunteers, 1,500; total, 1,500.

War with Mexico, from April 24, 1846, to July 4, 1848; regulars, 30,954; militia and volunteers, 73,776; total, 112,230.

Apache, Navajo, and Utah War, from 1849 to 1855; regulars, 1,500; militia and volunteers, 1,061; total, 2,501.

Seminole Indian War, from 1856 to 1858; militia and volunteers, 3,687; total, 3,687.

Civil War‡, from 1861 to 1865; total, 2,772,408.

Spanish-American War, from April 21, 1898, to Aug. 12, 1898; total, §274,717.

War in the Philippines, from 1899 to 1902; total, 153,000.

* Including all branches of the service.
† Naval forces engaged. ‡ The number of troops on the Confederate side was about 600,000.
§ Troops actually engaged, about 60,000.



NUMBER OF PENSIONERS ON ROLLS AND AMOUNT OF PENSIONS

1895	970,524	\$140,959,361.37
1900	993,529	138,462,130.65

MILITARY RESOURCES OF EUROPE IN ABLE-BODIED MEN

Nations.	Population Capable of Bearing Arms.*
Austria	9,800,000
Belgium	1,460,000
Denmark	490,000
France	9,550,000
Germany	12,000,000
Great Britain†.....	12,000,000
Greece	495,000
Italy	7,500,000
Netherlands	1,050,000
Portugal	1,170,000
Russia‡	22,000,000
Spain	4,200,000
Sweden and Norway.....	1,600,000
Switzerland	720,000

* Inclusive of persons engaged in the general and local civil administration, railroads, necessary tillers of the soil, and others who would not be spared to the field except as a last resort. † Great Britain includes Canada and Australia, but not other colonies or India. ‡ Russian population in Europe only is considered.

GREAT LIBRARIES OF THE WORLD

	No. of Volumes.
National, Paris.....	2,500,000
British Museum, London.....	1,600,000
Imperial, St. Petersburg.....	1,000,000
Munich	1,000,000
Berlin	800,000
Library of Congress, Washington*.....	680,000
Public, Boston*.....	560,000
Darmstadt	550,000
Leipsic	550,000
Strasburg	525,000
Royal, Copenhagen	500,000
Imperial, Vienna	450,000
Bodleian, Oxford	450,000
Public, St. Petersburg.....	440,000
Stuttgart	430,000
Gottingen	425,000
National, Florence.....	425,000
Madrid	410,000
Buda-Pest	400,000
University of Chicago*.....	380,000
Harvard University*.....	300,000
Heidelberg	300,000
Astor, New York*.....	240,000
Vatican, Rome	225,000

*Exclusive of pamphlets. The Harvard University Library has 278,000, and the Library of Congress 210,000 pamphlets.

ILLITERACY STATISTICS

Illiterates, in the sense here signified, are those above 21 years of age who cannot read and write. The following tables show the number of such in seven great cities of the United States, and in representative states standing high and low in the scale. The proportions of native and foreign born, and white and colored are indicated. The percentages are based on the relation of the number of illiterates to the whole of the population above 21 years of age.

	Total illiterate.	Native born.....	Foreign born.....	Total white.....	Total colored....	Per cent of illiteracy.
New York City..	65,556	3,028	62,528	62,889	2,717	6.5
Chicago	20,572	1,236	19,336	19,649	682	4.0
Philadelphia	17,588	3,695	13,893	14,847	2,741	4.5
St. Louis.....	7,026	3,337	3,689	4,596	2,430	4.1
Boston	8,111	410	7,701	7,481	630	4.0
Baltimore	10,152	7,034	3,118	4,182	5,970	7.2
Cleveland	5,786	440	5,346	5,522	264	5.2

In certain states least in per cent of illiteracy:

Wyoming	1,636	657	979	1,040	596	4.3
Utah	2,470	1,163	1,307	1,619	851	3.7
South Dakota....	5,442	3,208	2,234	2,693	2,749	4.8
Oregon	6,978	1,958	5,020	2,160	4,818	4.8
Ohio	58,698	36,986	21,712	51,769	6,929	4.8
Nebraska	7,388	2,668	4,720	6,841	547	2.5
Minnesota	20,785	4,005	16,780	19,223	1,562	4.1
Kansas	14,214	9,891	4,323	9,846	4,368	3.4
Colorado	7,689	3,885	3,804	6,847	842	4.1
Iowa	17,061	8,788	8,273	15,981	1,080	2.7

Greatest in per cent of illiteracy:

Louisiana	122,638	116,087	6,551	32,039	90,599	37.6
West Virginia..	32,066	29,162	2,904	26,472	5,594	12.9
Virginia	113,353	112,090	1,263	36,493	76,860	25.3
Texas	113,783	91,545	22,238	51,790	61,993	15.4
Tennessee	105,851	105,078	773	52,418	53,433	21.7
South Carolina.	99,516	99,322	194	15,865	18,651	35.1
North Carolina.	122,658	122,496	162	54,474	68,184	29.4
New Mexico....	15,585	13,275	2,310	12,504	3,081	28.3
Nevada	2,271	1,490	781	475	1,796	12.8
Mississippi	118,054	117,509	545	12,472	105,582	33.8
Maryland	40,352	35,639	4,713	15,678	24,674	12.5
Kentucky	102,578	100,340	2,188	65,517	37,011	18.8
Indian T'y.....	15,482	14,970	512	8,477	7,005	15.9
Hawaii	27,363	722	26,641	3,335	24,028	34.4
Georgia	158,247	157,764	483	32,456	125,791	31.6
Florida	30,849	29,460	1,389	6,558	24,291	22.1
Delaware	7,538	6,332	1,206	3,945	3,593	14.0
Arkansas	62,615	62,049	566	23,523	39,092	20.0
Arizona	10,533	6,327	4,206	4,776	5,757	23.9
Alaska	10,735	7,655	3,080	584	10,151	28.3
Alabama	139,649	138,934	715	31,614	108,035	33.7

HEIGHTS OF WATERFALLS

	Feet.
Cerosola Cascade, Alps.....	2,400
Yosemite Falls, California.....	1,500
Falls of Arne, Savoy.....	1,100
Virgin Tears Creek, Yosemite.....	1,000

	Feet.
Bridal Veil, Yosemite.....	900
Lauterbaum, Switzerland.....	900
Falls of Terni, near Rome.....	300
Montmorency Falls, Quebec.....	250
Fryer's Falls, Scotland.....	200
Niagara Falls, North America.....	164
Lidford Cascade, England.....	100



RELIGIONS AND DENOMINA-
TIONS OF THE WORLD

Creeds.	No. of Adherents.
Christianity	477,080,158
Confucianism	256,000,000
Hindooism	190,000,000
Mohammedanism	176,834,372
Buddhism	147,900,000
Taoism	43,000,000
Shintoism	14,000,000
Judaism	7,186,000
Polytheism	117,681,669

CHRISTIANITY.

Catholic Church	230,866,533
Protestant Churches	143,237,625
Orthodox Greek Church.....	98,016,000
Church of Abyssinia.....	3,000,000
Armenian Church	1,690,000
Coptic Church	120,000
Nestorians	80,000
Jacobites	70,000
Total.....	477,080,158

STATISTICS OF CHURCHES IN THE UNITED STATES.

DENOMINATIONS.	Churches.	Ministers.	Communi- cants.
ADVENTISTS:			
Evangelical	34	30	1,147
Advent Christian....	883	580	25,816
Seventh-Day	372	1,470	55,316
Church of God.....	19	29	647
Life and Advent Union	60	33	3,000
Church of God in Jesus Christ.....	94	95	2,872
ARMENIANS	15	21	8,500
BAPTISTS:			
Regular, North.....	7,415	9,374	973,820
Regular, South.....	12,058	18,963	1,608,413
Regular, Colored....	14,351	15,654	1,864,600
Six Principle	14	18	937
Seventh-Day	119	115	8,991
Freewill	1,619	1,486	85,109
Original Freewill ...	118	167	11,864
General	450	550	28,000
Separate	113	103	6,479
United	25	204	13,209

DENOMINATIONS.	Churches.	Ministers.	Communi- cants.
BAPTISTS—Continued.			
Church of Christ....	80	152	8,254
Primitive	2,040	3,222	121,347
Old Two Seed in the Spirit Predestinar- ian	300	473	12,851
BRETHREN (RIVER):			
Brethren in Christ..	152	78	4,000
Old Order, or Yorker	7	8	214
United Zion's Chil- dren	20	25	525
BRETHREN (PLYMOUTH):			
Brethren (I.).....	....	109	2,289
Brethren (II.).....	....	88	2419
Brethren (III.).....	....	86	1,235
Brethren (IV.).....	....	31	718
CATHOLICS:			
Roman Catholics....	11,636	12,062	8,610,226
Polish Branch.....	19	18	15,000
Old Catholic.....	6	5	10,000
Reformed Catholics..	6	6	1,500
CATHOLIC APOSTOLIC....	95	10	1,394
CHINESE TEMPLES.....	....	47	....
CHRISTADELPHIANS ....	....	63	1,277
CHRISTIANS	1,248	1,520	112,835
CHRISTIAN CATHOLIC (DOWIE)	55	50	40,000
CHRISTIAN MISSIONARY ASSOCIATION	10	13	754
CHRISTIAN SCIENTISTS..	12,000	600	1,000,000
CHRISTIAN UNION.....	183	294	18,214
CHURCH OF GOD (WINNE- BRENNERIAN)	460	580	38,000
CHURCH TRIUMPHANT (SCHWEINFURTH) ...	....	12	384
CHURCH OF THE NEW JERUSALEM (SWEDEN- BORGIANS)	143	173	7,679
COMMUNISTIC SOCIETIES:			
Shakers .....	....	15	1,728
Amana .....	....	7	1,600
Harmony .....	....	1	250
Separatists .....	....	1	200
Altruists .....	....	1	25
Church Triumphant (Koreshan Ecclesia) ....	....	5	205
Adonai Shomo .....	....	1	20
New Icaria.....	....	1	21
CONGREGATIONALIST: ...	5,614	5,604	629,874
DISCIPLES OF CHRIST...	6,528	10,528	1,149,982
DUNKARDS:			
German Baptists (Conservatives) ..	2,612	850	95,000
German Baptists (Old Order).....	150	100	3,500
German Baptists (Progressive)	231	173	12,787
Seventh-Day Baptists (German)	5	6	194
EPISCOPALIANS:			
Protestant Episcopal.	4,961	6,686	716,431
Reformed Episcopal.	103	104	9,743

DENOMINATIONS.	Churches.	Ministers.	Communi- cants.	DENOMINATIONS.	Churches.	Ministers.	Communi- cants.
EVANGELICAL BODIES:				MENNONITES—Continued.			
Evangelical Ass'n....	1,052	1,806	118,865	Bundes Conference ..	41	16	3,050
United Evangelical				Defenceless	20	11	1,176
Church	478	985	60,993	Brethren in Christ ..	45	82	2,953
FRIENDS:				METHODISTS:			
Friends (Orthodox) ..	1,279	820	91,868	Methodist Episcopal.	17,521	26,021	2,716,437
Friends (Hicksite)...	115	201	21,992	Union American M.			
Friends (Wilburite) ..	38	52	4,329	E.	63	61	2,675
Friends (Primitive) ..	11	9	232	African Methodist			
FRIENDS OF THE TEMPLE	4	4	340	Episcopal	5,659	5,775	673,504
GERMAN EVANGELICAL				African Union Meth.			
PROTESTANTS	44	52	36,156	Protestant	80	70	2,000
GERMAN EVANGELICAL				African Methodist			
SYNOD	909	1,129	203,574	Episcopal Zion ...	3,155	2,906	536,271
GREEK CHURCH:				Methodist Protestant	1,647	2,400	181,216
Greek Orthodox.....	4	4	20,000	Wesleyan Methodist .	587	506	17,201
Russian Orthodox....	41	58	45,000	Methodist Episcopal,			
JEWS	201	570	1,058,135	South	6,041	14,244	1,457,864
LATTER-DAY SAINTS (MORMONS):				Congregational Meth-			
Church of Jesus				odist	210	240	20,000
Christ of Latter-				Congregational Meth.			
Day Saints.....	1,700	796	300,000	(Colored)	5	5	319
Reorganized Church				New Congregational			
of Jesus Christ of				Methodist	20	17	1,059
Latter-Day Saints				Zion Union Apostolic.	30	27	2,346
(Seced'g M'rm'ns)..	2,200	600	45,500	Colored Methodist ...	2,187	1,300	199,206
LUTHERANS:				Primitive Methodist.	65	92	6,470
(General Bodies):				Free Methodist	944	1,123	28,588
General Synod....	1,226	1,568	194,442	Independent Meth-			
United Synod in				odist	8	14	2,569
the South	215	390	38,639	Evangelist Mission-			
General Council... 1,156	2,019	370,409		ary	87	13	4,600
Synodical C'nf'r'ce.	2,029	2,650	581,029	MORAVIANS	118	111	14,817
(Independent Synods):				PRESBYTERIANS:			
United Norwegian.	354	1,083	126,872	Presbyterian in U. S.			
Joint Syn'd of Ohio	457	604	77,362	of A. (North).....	7,335	7,469	973,433
Buffalo	25	39	4,600	Cumberland Presby-			
Hauge's, Norweg'n.	97	205	11,483	terian	1,734	2,957	180,192
Texas	11	14	1,700	Cumberland Presby-			
German of Iowa...	402	824	74,058	terian (Colored)...	400	150	39,000
Norweg'n Lutheran	272	725	67,208	Welsh Calvinistic ...	105	185	12,000
Michigan	56	86	7,860	United Presbyterian.	918	911	115,901
Danish in America	47	66	10,000	Presbyterian in U. S.			
Icelandic	8	26	3,350	of A. (South).....	1,461	2,959	225,890
Immanuel	45	50	6,118	Associate Ch. of			
Suomai, Finnish ..	11	50	5,925	North America ...	12	31	1,053
Norwegian Free... 125	375	37,500		Associate Ref. Synod			
Danish United.....	84	151	8,506	of the South	104	131	11,344
Independent Con-				Reform Pres. in the			
gregations	85	200	25,000	U. S. (Synod).....	124	113	9,790
WALDENSTROMIANS ...	140	150	20,000	Reform Pres. in N.			
MENNONITES:				A. (Gen. Synod)...	33	36	5,000
Mennonite	418	228	22,443	Reform Presb. (Cove-			
Bruederhoef	9	5	352	nanter).....	1	1	40
Amish	365	124	13,051	Reform Presb. in U.			
Old Amish	71	22	2,038	S. & Canada.....	1	1	608
Apostolic	2	2	209	REFORMED:			
Reformed	43	34	1,680	Reformed in America			
General Conference .	138	79	10,395	(Dutch)	698	619	107,594
Church of God in				Reformed in U. S.			
Christ	18	18	471	(German)	1,082	1,660	243,545
Old (Wisler)	17	15	610	Christian Reformed..	96	145	18,096

Cities.	Census Year.	Popu- lation.	Cities.	Census Year.	Popu- lation.
Magdeburg	1900	229,663	Bagdad	est.	145,000
Kristiania	1900	225,686	Aberdeen	1901	143,722
Hong Kong	1891	221,441	Valparaiso	1900	143,022
Salford	1901	220,956	Dortmund	1900	142,418
Lille	1896	216,276	Barmen	1900	141,947
Florence	1899	216,051	Dantzic	1900	140,539
Kobe, Japan	1898	215,780	Damascus	est.	140,500
Newcastle	1901	214,803	Manheim	1900	140,384
Dusseldorf	1900	213,767	Fez, Morocco	est.	140,000
Leicester	1901	211,574	Oporto	1890	138,860
Stettin	1900	210,680	Oldham, England	1901	137,238
Delhi	1901	208,385	Saratov	1897	137,109
Toronto	1901	207,971	St. Etienne	1896	136,030
Chemnitz	1900	206,584	Aachen	1900	135,235
Jersey City	1900	206,433	Patna	1901	135,172
The Hague	1899	205,328	Catania	1899	134,680
Valencia	1897	204,768	Croydon, England	1901	133,875
Louisville	1900	204,737	Denver	1900	133,859
Benares	1901	203,095	Toledo	1900	131,822
Minneapolis	1900	202,718	Kazan	1897	131,508
Smyrna	est.	201,000	Allegheny	1900	129,896
Seoul, Korea.....	est.	201,000	Lemberg	1891	128,419
Cawnpore	1901	197,000	Brunswick	1900	128,177
Yokohama	1898	193,762	Colombo, Ceylon	1891	127,836
Charlottenburg, Prussia	1900	189,290	Blackburn	1901	127,527
Portsmouth, England	1901	189,160	Aleppo	est.	127,150
Agra	1901	188,300	Goteborg	1899	126,849
Konigsberg	1900	187,897	Malaga	1897	125,579
Prague	1891	184,109	Columbus	1900	125,560
Mandelay	1901	182,498	Roubaix	1896	124,661
Tabriz	1881	180,000	Nagpur	1901	124,599
Stuttgart	1900	176,318	Nantes	1896	123,902
Allahabad	1901	175,748	Brighton	1901	123,478
Providence	1900	175,597	Srinagar	1901	122,536
Kharkov	1897	174,846	Hiroshima.....	1898	122,306
Bahia	1890	174,412	Yekaterinoslav	1897	121,216
Liege	1899	171,031	Lahore	1901	120,058
Indianapolis	1900	169,164	Bogota	1886	120,000
Bolton	1901	168,205	Rostov-on-Don	1897	119,889
Cardiff	1901	164,420	Havre	1896	119,470
Kansas City, Mo.....	1900	163,752	Essen, Germany	1900	118,863
Bremen	1900	163,418	Beirut	est.	118,800
St. Paul	1900	163,065	Worcester	1900	118,421
Ghent	1899	163,030	Surat	1901	118,364
Rochester	1900	162,608	Bareilly	1901	117,433
Amritsar	1901	162,548	Posen	1900	117,014
Altona, Germany	1900	161,507	Meerut	1901	116,642
Dundee	1901	160,871	Karachi	1901	115,407
Vilna	1897	159,568	Willesden	1901	114,815
Jaipur	1901	159,550	Rhondda	1901	113,735
Bangalore	1901	159,030	Gratz	1891	113,540
Bologna	1899	158,975	Rouen	1896	113,219
Trieste	1891	158,344	Astrakhan	1897	113,001
Howrah	1901	157,847	Preston	1901	112,982
Venice	1899	157,785	Basle	1900	112,842
Elberfeld	1900	156,937	Norwich	1901	111,728
Halle-on-Salle	1900	156,611	Pernambuco	1890	111,556
Messina	1899	156,552	Athens	1896	111,486
Tunis	est.	153,000	Poona	1901	111,385
Strasburg	1900	150,268	Birkenhead	1901	110,926
Zurich.	1900	150,239	Tula	1897	110,048
Toulouse	1896	149,963	Gateshead	1901	109,887
Adelaide	1899	148,644	Kishinev	1897	108,796
Ahmadabad	1891	148,412	Murcia, Spain	1897	108,408
Sunderland	1901	146,565	Syracuse	1900	108,374
Seville	1897	146,205	New Haven	1900	108,027

Cities.	Census Year.	Popu-lation.
Rheims	1896	107,963
Kiel, Germany	1900	107,938
Plymouth	1901	107,509
Nagasaki	1898	107,422
Krefeld	1900	106,928
Kassel, Germany	1900	106,001
Derby	1901	105,785
Leghorn	1899	105,767
Madura	1901	105,501
Paterson, N. J.	1900	105,171
Salonica	est.	105,000



THE WORLD'S HIGHEST MOUNTAINS

Name and Country.	Ft. High.	Miles
Mount Everest (Himalayas), Tibet.	29,002	5¾
Aconcagua, the highest in America, Chile	22,422	4
Sorato, Bolivia	21,284	4
Illimani, Bolivia	21,145	4
Chimborazo, Ecuador	21,422	4¾
Hindoo-Koosh, Afghanistan	20,600	3¾
Mount McKinley, highest in North America, Alaska	20,464	3¾
Demavend, highest of Elburz Mountains, Persia	20,000	3¾
Cotopaxi, highest volcano in the world, Ecuador	19,496	3¾
Antisana, Ecuador	19,150	3½
St. Elias, Alaska	17,850	3½
Popocatepetl, volcano, Mexico	17,540	3½
Mauna Loa, highest in Oceanica, Hawaii	16,000	3
Mount Brown, highest peak of Rocky Mountains, British America.....	15,900	3
Mont Blanc, highest in Europe, Alps, France	15,732	3
Mont Rosa, next highest peak of Alps, Italy	15,150	2¾
Limit of perpetual snow at the equator	15,207	2¾
PicLinca, Ecuador	15,924	3
Mount Whitney, California	14,887	2¾
Mount Fairweather, Alaska	14,500	2¾
Mount Shasta, California	14,442	2¾
Mount Ranier, Washington	14,444	2¾
Long's Peak, Rocky Mountains, Colorado	14,271	2¾
Mount Ararat, Armenia.....	14,320	2½
Pike's Peak, Colorado.....	14,216	2½
Mount Ophir, Sumatra.....	13,800	2½
Fremont's Peak, Rocky Mountains, Wyoming	13,570	2½
Mount St. Helens, Washington.....	13,400	2½
Peak of Teneriffe, Canaries.....	12,182	2½
Miltzin, highest of Atlas Mountains, Morocco	11,500	2
Mount Hood, Oregon.....	11,500	2
Mount Lebanon, Syria.....	10,533	2
Mont Perda, highest of Pyrenees, France	10,950	2

Name and Country.	Ft. High.	Miles
Mount Etna, volcano, Sicily.....	10,835	2
Monte Corno, highest of Apennines, Naples	9,523	1¾
Sneehattan, highest Dovrefield Mountains, Norway	8,115	1½
Pindus, highest in Greece.....	7,677	1½
Mount Sinai, Arabia	6,541	1¼
Mitchell Mountain, highest in North Carolina	7,350	1½
Mount Washington, highest White Mountains, N. Hampshire.....	6,285	1¼
Mount Marcy, highest in New York.	5,402	1
Mount Hecla, volcano, Iceland.....	5,104	1
Ben Nevis, highest in Great Britain, Scotland	4,406	¾
Mansfield, highest of Green Mountains, Vermont.....	4,280	¾
Peaks of Otter, Virginia.....	4,260	¾
Mount Vesuvius, Naples.....	4,253	¾
Round Top, highest of Catskill Mountains, New York.....	3,804	¾



HEIGHTS OF THE TALLEST MONUMENTS, TOWERS AND STEEPLES IN THE WORLD

	Feet.
Paris, Eiffel Tower.....	989
Washington, Washington Monument.....	555
Egypt, Pyramid of Cheops.....	486
Belgium, Antwerp Cathedral.....	476
France, Strasburg Cathedral.....	474
Egypt, Pyramid of Cephrenes.....	456
Rome, St. Peter's Church.....	448
Germany, St. Martin's Church at Landshut.	411
England, St. Paul's Church, London.....	365
England, Salisbury Cathedral.....	400
Italy, Cathedral at Florence.....	386



LENGTHS OF THE WORLD'S PRINCIPAL RIVERS

NORTH AMERICA.	
Rivers.	Miles.
Missouri to the Gulf (forming the longest river in the world).....	4,200
Missouri (to its junction with the Mississippi)	2,900
Mississippi proper	3,200
Mackenzie	2,300
St. Lawrence	2,000
Arkansas	2,000
Saskatchewan and Nelson.....	1,900
Yukon	1,600
Rio Grande	1,500
Nebraska	1,200
Red River	1,200
Columbia	1,400
Colorado	2,000

NORTH AMERICA—Continued.

Rivers	Miles.
Yellowstone	1,000
Ohio	950
Kansas	900
Tennessee	800
Fraser	750
Red River of the North.....	700
Brazos	650
Wisconsin	600
Cumberland	600
Alabama	600
Wabash	550
Appalachicola	550
Susquehanna	500
Potomac	500
James	500
Roanoke	500
Savannah	500
St. John	450
Connecticut	450
Great Pedee	450
Altamaha	400
Sacramento	400
Penobscot	350
Hudson	350
Cape Fear	350
Pearl	350
Nueces	350
Sabine	350
Severn	300
Kennebec	300
Delaware	300

SOUTH AMERICA.

Amazon	3,750
Rio de la Plata.....	2,300
Madeira	2,000
Orinoco	1,550
San Francisco	1,550
Tocantins	1,100
Colorado	1,000
Rio Negro	1,000
Magdalena	900
Parnaiba	900

EUROPE.

Volga	2,000
Don	1,300
Danube	1,800
Dnieper	1,080
Rhine	880
Dvina.....	700
Petchora	737
Elbe	737
Vistula	691
Loire	600
Tagus	550
Dneister	500
Guadiana	500
Seine	498
Douro	450
Oder	450
Rhone	450
Po	450
Mezene	400
Desna	400
Guadalquiver	400

EUROPE—Continued.

Rivers	Miles.
Duna	350
Niemen	350
Ebro	350
Dahl	300
Bug	300
Weser	300
Garonne	300
Thames	215

ASIA.

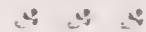
Yenesei	3,400
Yang-tse-Kiang	3,320
Ob	3,000
Hoang-Ho	2,800
Lena	2,700
Amur	2,650
Brahmaputra	2,300
Cambodia	2,000
Indus	1,850
Euphrates	1,750
Ganges	1,600

AFRICA.

Nile	4,100
Niger	3,000
Congo	2,900
Zambesi	1,800
Orange	1,000
Limpopo	900
Senegal	800

AUSTRALIA.

Murray	1,300
Darling	1,200



AREA AND DEPTH OF OCEANS

Area of oceans and inland seas connected with them 142,132,980 square miles, or 72 per cent of total surface of the earth.

Area of Arctic ocean estimated at 4,632,000 square miles. Atlantic ocean, 34,301,400 square miles; greatest depth "International Deep," off St. Thomas Island, West Indies, 27,366 feet. Indian ocean, 28,615,600 square miles. Pacific ocean, 67,699,630 square miles, and 9,000 by 12,000 miles in greatest extent, comprises nearly one-half the total water area; greatest depth sounded, "Tuscarora Deep" north of Japan, 27,930 feet. Area of Antarctic ocean estimated at 6,040,000 square miles, depth 4,920 feet. Supposed depth of 83 per cent of total ocean area more than 6,000 feet.

RACES OF MANKIND

The following is compiled from the arrangement by the Ethnologist Figuier and others:

WHITE RACE.

- | | | | |
|---------------------|---|------------------------|---|
| European
Branch. | { | Teutonic Family..... | Scandinavians, Germans, English. |
| | | Latin Family..... | French, Spaniards, Italians, Moldo-Wallachians. |
| | | Slavonian Family..... | Russians, Finns, Bulgarians, Servians, Magyars, Croats,
Tchecks, Poles, Lithuanians. |
| | | Greek Family..... | Greeks, Albanians. |
| Aramean
Branch. | { | Libyan Family..... | Egyptians, Berbers. |
| | | Semitic Family..... | Arabs, Jews, Syrians. |
| | | Persian Family..... | Persians, Afghans, Kurds, Armenians, Ossetines. |
| | | Georgian Family..... | Georgians. |
| | | Circassian Family..... | Circassians, Mingrelians. |

YELLOW RACE.

- | | | | |
|------------------------|---|------------------------|---|
| Hyperborean
Branch. | { | Lapp Family..... | Samoyede, Kamtschadale, Eskimo, Tenissian, Jukaghir-
ite, and Koriak Families. |
| | | | |
| Mongolian
Branch. | { | Mongol Family..... | Mongols, Kalmucks, Buriats. |
| | | Tungus Family..... | Tunguses, Manchus. |
| | | Turk Family..... | Turkomans, Kirghis, Nogays, Osmanlis. |
| | | Yakut Family..... | Yakuts. |
| Sinaic
Branch. | { | Chinese Family..... | Chinese. |
| | | Japanese Family..... | Japanese. |
| | | Indo-Chinese Family... | Burmese, Siamese. |

BROWN RACE.

- | | | | |
|----------------------|---|------------------------|--|
| Hindoo
Branch. | { | Hindu Family..... | Sikhs, Jats, Rajpoots, Mahrattas, Bengalese, Cingalese. |
| | | Malabar Family..... | Malabars, Tamals, Telingas. |
| Ethiopian
Branch. | { | Abyssinian Family.... | Abyssinians, Berabras, Gallas. |
| | | Fellan Family..... | Fellans. |
| Malay
Branch. | { | Malay Family..... | Malays, Javanese, Battas, Bougis, Maccassars, Dyaks,
Tagals. |
| | | Polynesian Family.... | Maoris, Tongas, Tahitians, Pomotouans, Marquesans,
Hawaiians. |
| | | | |
| | | Micronesian Family.... | Ladrone, Caroline, and Mulgrave Islanders. |

RED RACE.

- | | | | |
|---------------------|---|------------------------|---|
| Southern
Branch. | { | Andian Family..... | Quichuas (or Incas), Antis, Andians, Araucanians. |
| | | Pampean Family..... | Patagonians, Puelches, Charruas, Tobas, Moxas, Abi-
pous, etc. |
| | | Guarani Family..... | Guaranis, Bocotudos. |
| Northern
Branch. | { | Southern Family..... | Aztecs, Mayas, Lencas, Othomis, Tarascas, etc. |
| | | Northeastern Family... | Cherokees, Hurons, Iroquois, Sioux, Apaches, Co-
manches, Creeks, etc. |
| | | Northwestern Family.. | Chinooks, Digger Indians, Nootkans, etc. |

BLACK RACE.

- | | | | |
|--------------------|---|-----------------------|--------------------------------|
| Western
Branch. | { | Kaffir Family..... | |
| | | Hottentot Family..... | |
| | | Negro Family..... | |
| Eastern
Branch | { | Papuan Family..... | Fijians, New Caledonians, etc. |
| | | Andaman Family..... | Andamans, Australians. |

GAZETTEER OF THE WORLD

COMPRISING ALL THE GEOGRAPHICAL AND POLITICAL DIVISIONS OF
THE EARTH; THEIR NAMES, AREAS, AND POPULATIONS

Based Upon the Latest Census Reports and
Official Estimates

In the following pages no attempt has been^e made to present all the matter usually included in gazetteers; rivers, lakes, mountains, et cetera, do not change, and as such subjects are given in so many books, they have been omitted from these pages to make room for subjects about which recent information is difficult to obtain.

In brief, this Gazetteer gives all the geographical and political divisions of the world; the principal subdivisions, as provinces, states, territories, counties; all cities of 25,000 or more inhabitants (with a few exceptions where reliable information has not been obtainable); the states, territories, and possessions of the United States, and under each all incorporated cities and towns of 1,000 or more inhabitants, as returned by the census of 1900.

The following signs and abbreviations have been used:

*	<i>the capital of a state or nation</i>	Eng.	<i>England, English</i>	p. or pop.	<i>population</i>
		Fr.	<i>French</i>	pen.	<i>peninsula</i>
□	<i>square miles</i>	Ger.	<i>German</i>	posses.	<i>possession</i>
Am.	<i>America</i>	inc.	<i>including</i>	prov.	<i>province</i>
cen.	<i>central</i>	ind.	<i>independent</i>	Rus.	<i>Russian</i>
co.	<i>county</i>	isl.	<i>island</i>	So.	<i>South, Southern</i>
dep.	<i>dependency</i>	mts.	<i>mountains</i>	ter.	<i>territory</i>
E.	<i>East, Eastern</i>	No.	<i>North, Northern</i>	W.	<i>West, Western</i>

A

Aachen, city, Prussia, p. 135,235.
Aarhus, city, Denmark, p. 33,308.
Aberdeen', city, Scotland, p. 153,108.
Abyssin'ia, iud. state, E. Africa, □ 150,000, p. 3,500,000.
Adan'a, city, Asia Minor, p. 45,000.
Adelaide, * South Australia, p. 148,644.
Aden, volcanic pen. on Arabian coast (British), □ 75, p. 41,910.
Adrianople, city, Turkey, p. 81,000.
Afghanistan', cen. Asia, □ 215,400, p. 2,360,000, * Kabul.
Africa, continent, □ 11,518,104, p. 170,000,000.
Agra, city, India, p. 188,300.
A'guas Calien'tes, state, Mexico, □ 2,950, p. 102,378.—Its * p. 35,052.
Aix-la-Chapelle', French name for Aachen, above.
Ajmere', city, India, p. 75,759.
Ajmer'-Marwa'ra, prov. India, □ 2,711, p. 476,330.
Akron, Ohio, p. 42,728.
Alabama, So. cen. state, □ 52,250, p. 1,828,697, * Montgomery.
Incorporated cities and towns of 1,000 pop. or more in 1900:
Alabama City 2,276
Alexander ... 1,001
Anniston 9,695
Athens 1,010
Attalia 1,692
Auburn 1,447
Avondale 3,060
Bessemer 6,358
Birmingham .38,415
Brewton 1,382
Bridgeport ... 1,247
Columbia 1,132

Alabama.—Continued.

Columbiana . 1,075
Cullman 1,255
Dadeville 1,136
Decatur 3,114
Demopolis ... 2,606
Dothan 3,275
Ensley 2,100
Eufaula 4,532
Evergreen ... 1,277
Florence 6,478
Fort Deposit. 1,078
Fort Payne... 1,037
Gadsden 4,282
Geneva 1,032
Girard 3,840
Greensboro .. 2,416
Greenville ... 3,162
Huntsville ... 8,068
Jackson 1,039
Jacksonville .1,176
Jasper 1,661
Lafayette 1,629
Lanett 2,909
Marion 1,698
Mobile 38,469
Montgomery ...30,346
New Decatur... 4,437
Opelika 4,245
Oxanna 1,184
Oxford 1,372
Ozark 1,570
Phoenix 4,163
Piedmont 1,745
Pratt City..... 3,485
Prattville 1,929
Roanoke 1,155
Russellville ... 1,602
Scottsboro 1,014
Selma 8,713
Sheffield 3,333
Talladega 5,056
Troy 4,097
Tuscaloosa 5,094
Tuscumbia 2,348
Tuskegee 2,170
Union Springs.. 2,634
Uniontown 1,047
Warrior 1,018
Wilsonville 1,095
Woodlawn 2,848
Alaska, ter. of U. S., □ 590,884, p. 63,592,
* Sitka.
Cities and towns of more than 1,000 pop. in 1900:
Juneau 1,864
Nome 12,488
Sitka 1,396
Skagway 3,117
Albany, * N. Y., p. 94,151.
Alberta, ter. Canada, □ 100,000.

Alcoy, city, Spain, p. 31,099.
 Aleppo, city, Syria, p. 127,150.
 Alessandria, city, Italy, p. 79,015.
 Alexandria, city, Egypt, p. 319,766.
 Algeria, Fr. posses. in No. Africa, □ 184,474, p. 4,430,000, * Algiers, p. 96,784.
 Alicante, city, Spain, p. 49,463.
 Aligarh, city, India, p. 70,127.
 Allahabad, city, India, p. 175,748.
 Allegheny, Pa., p. 129,896.
 Allentown, Pa., p. 35,416.
 Almeria, city, Spain, p. 46,806.
 Alost, city, Belgium, p. 29,746.
 Alsace-Lorraine, Ger. imperial ter., □ 5,600, p. 1,717,451, * Strassburg, p. 135,608.
 Altenburg, * Saxe-Altenburg, Germany, p. 33,621.
 Altona, city, Prussia, p. 161,507.
 Altoona, Pa., p. 38,973.
 Alwar, city, India, p. 56,740.
 America, North, continent, □ 7,952,386, p. 97,500,000—South, continent, □ 6,844,602, p. 40,500,000.
 A'miens, city, France, p. 88,731.
 Amoy, city on Haimun Isl., China, p. 96,000.
 Amrit'sar, city, India, p. 162,548.
 Amsterdam, city, Holland, p. 523,557.
 Anam' (or Annam), Fr. posses. in Asia, So. of China, □ 88,780, p. 5,000,000, * Hue, p. 30,000.
 Anatolia, see Asia Minor.
 Anco'na, city, Italy, p. 60,428.
 Andaman' Islands (over 200), Bay of Bengal (British), □ 2,000, p. 29,000, * Port Blair, p. 15,000.
 Andijan', city, Rus. Turkestan, p. 46,680.
 Andorra, republic in Pyrenees mts. between France and Spain, □ 175, p. 6,000.
 Angers, city, France, p. 77,164.
 An'glesey, co. Wales, □ 275, p. 50,590.
 Angola (Portuguese W. Africa), □ 484,800, p. 4,119,000, * St. Paul de Loanda.
 Angouleme, city, France, p. 38,068.
 An'halt, Ger. duchy, □ 906, p. 316,027, * Dessau, p. 42,375.
 Antana'narivo', * Madagascar, p. 260,000.
 Antwerp, city, Belgium, p. 282,018.
 Arabia, pen. So. W. Asia, □ 1,200,000 (est.), p. (est.) 5,000,000.
 Ar'ad, city, Hungary, p. 53,800.
 Arequi'pa, city, Peru, p. 35,000.
 Arezzo, city, Italy, p. 45,854.
 Ar'gentine Republic, So. Am., □ 1,113,849, p. 4,094,911, * Buenos Ayres.
 Arizona, ter. W. part U. S., □ 113,020, p. 122,931, * Phoenix.
 Incorporated cities and towns of 1,000 pop. or more in 1900:
 Flagstaff 1,271 Prescott 3,559
 Globe 1,495 Tucson 7,531
 Jerome 2,861 Winslow 1,305
 Nogales 1,761 Yuma 1,519
 Phoenix 5,544

Arkansas, So. cen. state, □ 53,850, p. 1,311,-564, * Little Rock.
 Incorporated cities and towns of 1,000 pop. or more in 1900:
 Arkadelphia . 2,739 Fort Smith 11,587
 Arkansas City 1,091 Gurdon 1,045
 Augusta 1,040 Hamburg 1,260
 Batesville 2,327 Harrison 1,551
 Benton 1,025 Helena 5,550
 Bentonville .. 1,843 Hope 1,644
 Black Rock... 1,400 Hot Springs... 9,973
 Brinkley 1,648 Huntingdon 1,298
 Camden 2,840 Jonesboro 4,508
 Clarendon 1,840 Junction City... 1,251
 Clarksville .. 1,086 Little Rock.... 38,307
 Coal Hill.... 1,341 Magnolia 1,614
 Conway 2,003 Malvern 1,582
 Corning 1,041 Marianna 1,707
 Dardanelle .. 1,602 Mena 3,423
 De Queen.... 1,200 Monticello 1,597
 Eldorado 1,069 Morrilton 1,707
 Eureka Spgs.. 3,572 Newport 2,866
 Fayetteville .. 4,061 Paragould 3,324
 Fordyce 1,710 Pine Bluff..... 11,496
 Forrest City.. 1,361 Prescott 2,005

Arkansas.—Continued.

Rogers 2,158 Stamps 1,021
 Russellville ... 1,832 Stuttgart 1,258
 Scarcy 1,995 Texarkana 4,914
 Siloam Sp'ngs 1,748 Van Buren..... 2,573
 Springdale 1,251 Wynne 1,629

Armenia, country, W. Asia, belonging to Turkey, Persia and Russia; Turkish Armenia and Khurdistan form a province; □ 72,-491, p. 2,472,400.
 Arnhem, city, Holland, p. 57,248.
 Ascension, isl. So. Atlantic (British), □ 35, p. 430.
 Ascoli Piceno, city, Italy, p. 31,499.
 Asia, largest continent, □ 17,039,066, p. 850,-000,000.
 Asia Minor (or Anatolia), part of Turkish Empire, □ 194,389, p. 9,355,000.
 Assam', prov. India, □ 49,004, p. 6,122,201.
 Assiniboia, ter. Canada, □ 90,340.
 Assiout, city, Egypt, p. 42,078.
 Astrakhan', city, Russia, p. 113,001.
 Asuncion, * Paraguay, p. 45,000.
 Athabasca, ter. Canada, □ 251,300.
 Athens, * Greece, p. 111,486.
 Atlanta, * Ga., p. 111,486.
 Atlantic City, N. J., p. 27,838.
 Auburn, N. Y., p. 30,345.
 Auckland, city, New Zealand, p. 31,424.
 Augsburg, city, Bavaria, Germany, p. 81,896.
 Augusta, Ga., p. 39,441.
 Australasia, including Australia and Oceania, □ 3,458,000, p. 5,684,600.
 Australia, Commonwealth of, comprises states of New South Wales, Victoria, Queensland, So. Australia, W. Australia and Tasmania; □ 2,972,573, p. 3,777,212, temporary * Melbourne.
 Austria, empire, part of Austria-Hungary, □ 115,903, p. 26,107,300, * Vienna.
 Austria-Hungary, European dual monarchy (Austrian Empire and the Hungarian Kingdom), □ 240,942, p. 45,310,831.
 Avelli'no, city, Italy, p. 28,579.
 Avignon, city, France, p. 45,107.
 Ayr, city, Scotland, p. 28,624.
 Azov', city, Russia, p. 25,488.

B

Baden, Ger. grand-duchy, □ 5,821, p. 1,866,584, * Karlsruhe.
 Bagdad, city, Mesopotamia (Turkey), Asia, p. 145,000.
 Bahamas, isls. British West Indies, □ 5,450, p. 47,565.
 Bahi'a, city, Brazil, p. 174,412.
 Bahrein' Islands, Persian Gulf (British), p. 70,000, * Moharek, p. 22,000.
 Baireuth (see Bayreuth).
 Baku', city, Caucasus, Russia, p. 112,253.
 Bale, Fr. name for Basel, Switzerland.
 Ballarat', city, Victoria, Australia, p. 46,410.
 Baltimore, Md., p. 508,957.
 Baluchistan', state dependent on India, So. Cen. Asia, □ 130,000, p. 500,000, * Kalat.
 Bamberg, city, Bavaria, Germany, p. 38,940.
 Bangalore', city, India, p. 159,030.
 Bangkok, * Siam, p. 250,000.
 Barbados, isl., Lesser Antilles (British), □ 166, p. 192,000, * Bridgetown.
 Barca (or Benghazi), region, No. Africa, E. of Tripoli, ancient Cyrenaica, Turkish prov. * Benghazi, p. 500,000.
 Barcelona, city, Spain, p. 509,589.
 Bareilly, city, India, p. 117,433.
 Barfurush', city, Persia, p. 50,000.
 Bari, city, Italy, p. 82,833.
 Barmen, city, Prussia, p. 141,947.
 Baroda, state, India, □ 8,226, p. 1,950,927. Its * p. 103,782.
 Barquisme'to, city, Venezuela, p. 31,476.
 Barrow-in-Furness, town, Eng., p. 57,584.
 Basel, city, Switzerland, p. 112,253.
 Basu'toland, So. Africa, N. E. Cape Colony, British, □ 10,293, p. 250,000, * Maseru, p. 862.
 Batavia, * Java, p. 115,567.
 Bath, city, Eng., p. 49,817.

Bavaria, Ger., kingdom, □ 29,282, p. 6,175,-153, * Munich.
 Bay City, Mich., p. 27,628.
 Bayonne, N. J., p. 32,722.
 Bayreuth, city, Bavaria, Germany, p. 27,693.
 Bechuanaland Protectorate, So. Africa, N. and W. of Transvaal, British, □ 213,000, p. 200,000, * Palachwe, p. 25,000.
 Bedford, co., Eng., □ 466, p. 171,700.
 Bei'rut (ba'root), city, Syria, p. 118,800.
 Belem, city, Brazil, p. 50,064.
 Belfast, city, Ireland, p. 348,965.
 Belgium, kingdom, Europe, □ 11,373, p. 6,-744,532, * Brussels.
 Belgrade, * Serbia, p. 59,494.
 Bella'ry, city, India, p. 57,700.
 Benares, city, India, p. 203,095.
 Ben'digo (Sandhurst), city, Victoria, Australia, p. 43,112.
 Benevento, city, Italy, p. 26,339.
 Bengal States, British India, □ 59,259, p. 3,735,715. Bengal, prov., India, □ 151,-543, p. 74,713,020, * Calcutta.
 Benghazi (or Barca which sec), Turkish prov., No. Africa, □ 54,900, p. 500,000.
 Berar, prov., India, □ 17,718, p. 2,752,418.
 Berdechev, city, Russia, p. 53,728.
 Bergamo, city, Italy, p. 47,206.
 Bergen, city, Norway, p. 72,179.
 Berks, co., Eng., □ 712, p. 180,366.
 Berlin, * German Empire, p. 1,884,151.
 Bermudas, islands, No. Atlantic, British, 20, p. 16,423, * Hamilton, p. 1,296.
 Bern (or Berne), * Switzerland, p. 63,994.
 Besancon, city, France, p. 57,556.
 Beziers, city, France, p. 48,868.
 Bhagalpur, city, India, p. 75,273.
 Bhutan, ind. state of Asia, □ 16,800, p. 35,000, * Punakha.
 Bika'nir, city, India, p. 53,071.
 Bilbao, city, Spain, p. 74,093.
 Binghamton, N. Y., p. 39,647.
 Birkenhead, city, Eng., p. 110,926.
 Birmingham, Ala., p. 38,415—city, Eng., p. 522,182.
 Bismarck Archipelago, islands, N. E. of New Guinea, □ 19,000.
 Bitlis, city, Armenia, p. 38,800.
 Blackburn, city, Eng., p. 127,527.
 Blagoveshchensk, city, Siberia, p. 32,606.
 Blumenau, city, Brazil, p. 40,000.
 Bochum, city, Prussia, p. 53,842.
 Bogota, * Colombia, p. 120,000.
 Bohemia, prov., Austria, □ 20,060, p. 6,318,-280.
 Bohol, isl., Philippines, □ 1,300.
 Bokhara, Rus. vassal state, Asia, □ 92,000, p. 2,500,000, * Bokhara, p. 75,000.
 Bolivia, republic, So. Am., □ 567,430, p. 1,310,000, * Sucre, p. 27,350.
 Bologna, city, Italy, p. 158,975.
 Bolton, city, Eng., p. 168,205.
 Boma, * Congo Free State, on Congo R.
 Bombay States, British India, □ 61,457, p. 6,891,691. Bombay (presidency), India, □ 125,144, p. 18,584,496, * Bombay, p. 770,-843.
 Bootle, town, Eng., p. 58,558.
 Bordeaux, city, France, p. 257,500.
 Borneo, isl. East Indies, belongs to Dutch and British, □ 243,843, p. 1,355,580.
 Bos'nia and Herzegovina, Turkish provs. under government of Austria-Hungary, □ 23,262, p. 1,568,092, * Sarajevo, p. 38,083.
 Boston, * Mass., p. 560,822.
 Boulogne, city, France, p. 46,807.
 Boulogne-sur-Seine, city, France, p. 37,418.
 Bourges, city, France, p. 43,587.
 Bournemouth, town, Eng., p. 47,003.
 Bradford, city, Eng., p. 279,809.
 Braga, city, Portugal, p. 23,089.
 Brai'la, city, Rumania, p. 58,392.
 Brazil, republic, So. Am., □ 3,218,130, p. 14,333,915, * Rio de Janeiro.
 Brecknock, co., Wales, □ 734, p. 54,211.
 Bremen, German free town, □ 99, p. 244,697.
 Brescia, city, Italy, p. 69,833.
 Breslau, city, Prussia, p. 422,738.
 Brest, city, France, p. 74,538.

Bridgeport, Conn., p. 70,996.
 Brighton, city, Eng., p. 123,478.
 Brisbane, * Queensland, Australia, p. 48,738.
 Bristol, city, Eng., p. 328,842.
 British Columbia, prov. Canada, □ 383,300, p. 190,000, * Victoria.
 British Empire, comprises The United Kingdom of Great Britain and Ireland, and India, the Colonies, Protectorates and Dependencies, □ 9,043,577, p. 382,898,200, * London.
 British Guiana, So. Am., □ 120,000, p. 278,-328, * Georgetown, p. 53,176.
 British Honduras, Crown colony, Ccn. Am., □ 7,562, p. 35,226, * Belize, p. 6,972.
 British North Borneo, No. part Isl. of Borneo, □ 31,106, p. 175,000, * Sandakan.
 British West African Colonies (inc. Gold Coast, Lagos, Gambia, and Sierra Leone which see).
 British West Indies, comprise six groups: Bahamas, Barbados, Jamaica with Turks Islands, Leeward Islands, Trinidad with Tobago, and Windward Islands.
 Brockton, Mass., p. 40,063.
 Bruges, city, Belgium, p. 53,050.
 Brunei, ter. on N. W. coast Borneo (British), □ 15,000, p. 45,000.
 Brunn, city, Austria, p. 108,944.
 Brunswick, Ger. duchy, □ 1,424, p. 464,251, * Brunswick, p. 128,177.
 Brussa, city, Asia Minor, p. 76,303.
 Brussels, * Belgium, on Senne R., p. (inc. suburbs) 570,844.
 Bucharest, * Rumania, p. 282,071.
 Buckeburg, * Schaumburg-Lippe, Ger., p. 5,620.
 Buckingham, co., England, □ 743, p. 196,844.
 Bu'dapest, * Hungary, p. 733,358.
 Buenos Ayres, (bway'nos ay'res), * Argentine Rep., on La Plata R., p. 795,323.
 Buffalo, N. Y., p. 352,387.
 Bukowina, prov., Austria, □ 4,035, p. 729,921.
 Bulgaria (inc. E. Roumelia), under suzerainty of Turkey, □ 37,860, p. 3,310,713, * Sofia.
 Burgos, city, Spain, p. 30,856.
 Burma States, British India, □ 62,661, p. 1,228,460.—Burma, prov. India, □ 171,430, p. 9,221,161.—Lower, * Rangoon.—Upper, * Mandalay.
 Burnley, city, Eng., p. 97,044.
 Burton-upon-Trent, town, Eng., p. 50,386.
 Bury, town, Eng., p. 58,028.
 Butte, Mont., p. 30,470.
 Byelostok, city, Russia, p. 63,927.

C

Cad'iz, city, Spain, p. 70,177.
 Caen (kon), city, France, p. 45,380.
 Cagli'ari, city, Italy, p. 45,761.
 Cairo, (ki-ro), * Egypt, p. 570,062.
 Calais, city, France, p. 56,940.
 Calcutta, * Bengal and British India, p. (with suburbs), 1,121,664.
 Calicut, city, India, p. 75,510.
 California, W. state, □ 158,360, p. 1,485,053, * Sacramento.
 Incorporated cities and towns of 1,000 pop. or more in 1900:

Alameda	16,464	Hayward	1,965
Anahcim	1,456	Healdsburg	1,869
Auburn	2,050	Hollister	1,315
Bakersfield	4,836	Kern	1,291
Benicia	2,751	Lincoln	1,061
Berkeley	13,214	Livermore	1,493
Chico	2,640	Long Beach	2,252
Colton	1,285	Los Angeles	102,479
Colusa	1,441	Los Gatos	1,915
Corona	1,434	Martinez	1,380
Emeryville	1,016	Marysville	3,497
Eureka	7,327	Merced	1,969
Fort Bragg	1,590	Modesto	2,024
Fresno	12,470	Monrovia	1,205
Gilroy	1,820	Monterey	1,748
Grass Valley	4,719	Napa	4,036
Hanford	2,929	National City	1,086

California.—Continued.

- Nevada City...3,250
 Oakland66,960
 Orange1,216
 Pacific Grove...1,411
 Palo Alto.....1,658
 Pasadena9,117
 Paso Robles...1,224
 Petaluma3,871
 Placerville1,748
 Pleasanton1,100
 Pomona5,526
 Red Bluff.....2,750
 Redding2,946
 Redlands4,797
 Redwood1,653
 Riverside7,973
 Rocklin1,050
 Sacramento ..29,282
 St. Helena....1,582
 Salinas3,304
 San Bern'dino 6,150
 San Diego....17,700
 San F'nisco 342,782
 San Jose.....21,500
 San Leandro..2,253
 San L's Obispo 3,021
 San Mateo....1,832
 San Pedro....1,787
 San Rafael...3,879
 Santa Ana....4,933
 Santa Barbara 6,587
 Santa Clara...3,650
 Santa Cruz...5,659
 Santa Monica..3,057
 Santa Rosa...6,673
 Sausalito1,628
 Selma1,083
 Sonora1,922
 So. Pasadena..1,001
 Stockton17,506
 Tulare2,216
 Ukiah1,850
 Vacaville1,220
 Vallejo7,965
 Ventura2,470
 Visalia3,085
 Watsonville ..3,528
 Whittier1,590
 Woodland2,886
 Yreka1,254
- Caltanissetta, city, Italy, p. 38,719.
 Cambodia, Fr. possess., Indo-China, □ 40,530, p. 1,500,000, * Pnom-Penh, p. 50,000.
 Cambridge, Mass., p. 91,886.—Co. Eng., □ 487, p. 120,634.
 Camden, N. J., p. 75,935.
 Campeche, state, Mexico, □ 18,087, p. 87,264.
 Canada, Dominion of, British No. Am., □ 3,653,946, p. 5,370,000, * Ottawa.
 Canary Islands, W. of Morocco, □ 2,808, p. 334,521.
 Cane'a, * Crete, p. 21,025.
 Canterbury, town, Eng. p. 24,868.
 Canton, Ohio, p. 30,667.—city, China, on Pearl R., p. (est.) 2,500,000.
 Cape of Good Hope (Cape Colony), So. Africa, British (comprises Colony proper E. & W. Griqualand, Tembuland, Transkei, Wal-fish Bay and Pondoland), □ 221,311, p. 1,527,224, * Cape Town, p. 51,251 (wlth sub-urbs, p. 83,718).
 Cape Verde Islands, Atlantic Ocean, belong to Portugal, □ 1,480, p. 114,130.
 Cara'cas, * Venezuela, p. 72,429.
 Car'diff, city, Wales, p. 164,420.
 Cardigan, co., Wales, □ 692, p. 61,076.
 Carinthia, prov., Austria, □ 4,005, p. 367,344.
 Carmarthen, co., Wales, □ 918, p. 135,326.
 Carnarvon, co., Wales, □ 563, p. 125,669.
 Carniola, prov., Austria, □ 3,856, p. 508,340.
 Caroline Islands, group in N. Pacific, belong to Germany, □ 560.
 Carthage, city, Spain, p. 86,245.
 Caserta, city, Italy, p. 35,060.
 Castellon, city, Spain, p. 31,272.
 Catania, city, Italy, p. 134,680.
 Catanzaro, city, Italy, p. 36,251.
 Caucasia, So. prov., Russia, □ 180,843, p. 9,248,695.
 Cawnpur', city, India, p. 197,000.
 Ceara', city, Brazil, p. 40,902.
 Cebu, isl., Philippines, □ 2,400.
 Cedar Rapids, Iowa, p. 25,656.
 Celebes, isl., Dutch E. Indies, □ 71,470, p. 1,997,860.
 Central Africa Protectorate, British, □ 42,217, p. 900,560, * Blantyre, p. 6,100.
 Central India States, British India, □ 78,571, p. 8,501,883.
 Central Provinces, British India, □ 86,501, p. 9,845,318.—States, British India, □ 29,375, p. 1,983,496.
 Certe, city, France, p. 32,729.
 Ceylon', isl., S. of India, British colony, □ 25,333, p. 3,477,094, * Coimbo.
 Charleston, S. C., p. 55,807.
 Charlottenburg, city, Prussia, p. 189,290.
 Chattanooga, Tenn., p. 30,154.
 Chehkiang, prov., China, □ 34,700, p. 11,589,000.
 Chelsea, Mass., p. 34,072.
 Chemnitz, city, Saxony, p. 206,584.
 Cherbourg, city, France, p. 40,783.
 Chester, Pa., p. 33,988.—co. Eng., □ 1,009, p. 601,070.—Its * p. 36,281.
 Chia'pas, state, Mexico, □ 27,222, p. 318,730.
 Chicago, Ill., p. 1,698,575.
 Chifu, city, China, on Gulf of Chili, p. 35,000.
 Chihuahua, state, Mexico, □ 87,802, p. 260,008.
 Chile, republic, So. Am., □ 290,829, p. 3,110,085, * Santiago.
 Chili (or Pe-chi-li), prov., China, □ 57,800, p. 17,937,000.
 Chillan', city, Chile, p. 35,052.
 China (Proper), division of Chinese Empire, □ 1,353,350, p. 383,000,000, * Peking.
 Chinese Empire, E. Asia, comprising China Proper, and the Dependencies of Manchuria, Mongolia, Tibet, Jungaria and East Turkestan, □ 4,234,910, p. 399,680,000, * Peking.
 Chinkiang, city, China, on Yangste R., p. 140,000.
 Christiania, * Norway, p. 225,686.
 Christmas Island, 200 mi. S. W. of Java, British.
 Cienfue'gos, city, Cuba, p. 30,038.
 Cincinnati, Ohio, p. 325,902.
 Clermont-Ferrand', city, France, p. 50,870.
 Cleveland, Ohio, p. 381,768.
 Clichy', city, France, p. 33,895.
 Coahuila, state, Mexico, □ 63,569, p. 237,815.
 Coast Land, prov., Austria, □ 3,084, p. 755,183.
 Coatbridge, town, Scotland, p. 160,871.
 Cochinchina, Fr. posses. S. of Anam, Indo-China, □ 23,160, p. 2,323,499, * Saigon.
 Coimbatore', city, India, p. 52,931.
 Colima, state, Mexico, □ 2,272, p. 55,264.
 Cologne, city, Prussia, p. 372,229.
 Colombia, republic, So. Am., □ 505,000, p. 3,878,000, * Bogota.
 Colombo, * Ceylon, p. 127,838.
 Colorado, W. state, □ 103,925, p. 539,700, * Denver.
 Incorporated cities and towns of 1,000 pop. or more in 1900:
 Alamosa,1,141
 Anaconda1,059
 Aspen3,303
 Black Hawk...1,200
 Boulder6,150
 Buena Vista...1,006
 Canyon City...3,776
 Central City...3,114
 Colorado City 2,914
 Colorado Sp's 21,085
 Cripple Cr'k..10,147
 Denver132,859
 Durango3,317
 Ellyria1,384
 Florence3,728
 Fort Collins...3,053
 Georgetown ...1,418
 Glenw'd Sp'gs.1,350
 Globeville2,192
 Golden City...2,152
 Goldfield2,191
 Grand Junct'n 3,503
 Greeley3,023
 Gunnison1,200
 Idaho Springs.2,502
 La Junta.....2,513
 Las Animas...1,192
 Leadville12,455
 Longmont2,201
 Loveland1,091
 Manitou1,303
 Montrose1,217
 Ouray2,196
 Pueblo28,157
 Rocky Ford...2,018
 Salida3,722
 Silverton1,360
 Telluride2,446
 Trinidad5,345
 Victor4,986
 Waisenburg ..1,033
 Columbus, * Ohio, p. 125,560.
 Comhaco'num, city, India, p. 59,688.
 Como, city, Italy, p. 36,426.
 Com'oro Islands, bet. Madagascar and Africa, belong to France, □ 620, p. 47,000.
 Concep'cion, city, Chile, p. 55,458.
 Congo Free State, W. Africa, □ 900,000, p. 30,000,000 (about 2,000 whites), * Boma.
 Connaught, prov. Ireland (inc. Galway, Leitrim, Mayo, Roscommon and Sligo counties), □ 6,867, p. 649,635.
 Connecticut, No. Atlantic state, □ 4,949, p. 908,420, * Hartford.
 Incorporated cities and towns of 1,000 pop. or more in 1900:
 Ansonia12,681
 Bethel2,561
 Branford2,473
 Bridgeport ...70,996
 Bristol6,268
 Danbury16,537
 Danielson2,823
 Derby7,930
 Greenwich2,420
 Guilford1,512
 Hartford79,850
 Jewett City...2,224

Connecticut.—Continued.

Litchfield	1,120	Shelton	2,837
Meriden	24,296	Southington	3,411
Middletown	9,589	So. Norwalk	6,591
Naugatuck	10,541	Stafford Sp'gs.	2,460
New Britain	25,998	Stamford	15,997
New Canaan	1,304	Stonington	2,278
New Haven	108,027	Torrington	8,360
New London	17,548	Wallingford	6,737
Norwalk	6,125	Waterbury	45,859
Norwich	17,251	West Haven	5,247
Putnam	6,667	Willimantic	8,937
Rockville	7,287	Winsted	6,804

Constantine, city, Algeria, p. 51,997.

Constantinople, * Turkey, p. 1,125,000.

Coorg, prov. British India, □ 1,583, p. 180,461.

Copenhagen, * Denmark, p. 375,251.

Cor'doba (or Cordova), city, Spain, p. 57,313.

— city, Argentine Republic, p. 47,609.

Cork, city, Ireland, p. 75,978.

Cornwall, co., Eng., □ 1,357, p. 322,960.

Coruna, city, Spain, p. 40,501.

Costa Rica, republic of Cen. Am., □ 23,000, p. 310,000, * San Jose.

Council Bluffs, Iowa, p. 25,802.

Courtrai, city, Belgium, p. 35,510.

Coventry, city, England, p. 69,877.

Covington, Ky., p. 42,938.

Cracow, city, Austria, p. 91,310.

Cremona, city, Italy, p. 38,785.

Crete (or Candia), isl. Mediterranean, under Turkish suzerainty, □ 3,326, p. 301,273. * Canea, p. 21,025.

Croatia and Slavonia, prov., Hungary, □ 16,733, p. 2,186,410, * Agram.

Cronstadt, city, Russia, p. 59,539.

Croydon, city, England, p. 138,885.

Cuba, largest of West Indian Isls., S. E. of Florida, □ 45,872, p. 1,572,797, * Havana. Cities of more than 5,000 pop. in 1899:

Caibarien	7,013	Pinar del Rio....	8,880
Camajuani ...	5,082	Placitas	5,409
Cardenas	21,940	Puerto Principe ..	25,102
Cienfuegos ...	30,038	Regla	11,363
Colon	7,175	Remedios	6,633
Gibara	6,841	Sagua la Grande ..	12,728
Guanabacoa ..	13,965	San Antonio de ..	8,178
Guanajay	6,483	los Banos.....	12,696
Guantanamo ..	7,137	Sancti Spiritus....	5,059
Guines	8,149	San Luis.....	13,763
Havana	235,981	Santa Clara.....	43,090
Holguin	6,045	Santiago	7,151
Manzanillo....	14,464	Santiago de las ..	11,120
Marianao	5,416	Vegas	
Matanzas	36,374	Trinidad	
Melena	5,016		

Cuddalore', city, India, p. 51,880.

Cuen'ca, city, Ecuador, p. 25,000.

Cumberland, co., Eng., □ 1,516, p. 266,960.

Cune'o, city, Italy, p. 28,793.

Curacao (Ku-ra-so'), Dutch colony off No. coast of Venezuela, inc. five islands and part of St. Martin, □ 403, p. 51,524.

Cyprus, isl. Mediterranean (British), □ 3,584, p. 209,286, * Nicosia, p. 12,515.

Czechuen, prov., China, □ 160,800, p. 67,713, -000.

Czernowitz, city, Austria, p. 69,619.

D

Dacca, city, India, p. 90,679.

Dahomey, kingdom on W. coast of Africa, Fr. posses., □ 60,000, p. 1,000,000, * Porto Novo, p. 50,000.

Dallas, Texas, p. 42,638.

Dalmatia, prov., Austria, □ 4,940, p. 591,597.

Damascus, city, Syria, p. 140,500.

Damiet'ta, city, Egypt, p. 31,515.

Danzig, city, Prussia, p. 140,539.

Darbhanga', city, India, p. 65,990.

Darmstadt, * Hesse, Germany, p. 63,745.

Davenport, Iowa, p. 35,254.

Dayton, Ohio, p. 85,333.

Debreczen (da-bret'sin), city, Hungary, p. 60,000.

Delaware, So. Atlantic state, □ 2,050, p. 184,735, * Dover.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Delaware City ..	1,132	Milford	2,500
Dover	3,329	Newark	1,213
Georgetown ..	1,658	Newcastle	3,380
Harrington ..	1,242	Seaford	1,724
Laurel	1,825	Smyrna	2,168
Lewes	2,259	Wilmington ...	76,508
Middletown ..	1,567		

Delhi, city, India, p. 208,385.

Denmark, kingdom of Europe, □ 15,289, p. 2,447,441, * Copenhagen.

Denbigh, co., Wales, □ 663, p. 131,588.

Denver, * Colo., p. 133,859.

Derby, co., Eng., □ 1,022, p. 504,755.—Its * p. 105,785.

Des Moines, * Iowa, p. 62,139.

Des'sau, * Anhalt, Germany, p. 42,375.

Detroit, Mich., p. 285,704.

Dev'on, co., Eng., □ 2,597, p. 437,210.

Devonport, town, Eng., p. 69,674.

Diar'bekr, city, Kurdistan, p. 34,000.

Dijon', city, France, p. 67,736.

District of Columbia, federal ter. U. S., □ 70, p. 278,718; Washington, * U. S. A., is co-extensive with the District.

Dorset, co., Eng., □ 988, p. 202,092.

Dortmund, city, Prussia, p. 142,418.

Douai (doo-a'), city, France, p. 31,397.

Dresden, city, Saxony, p. 395,349.

Dublin, * Ireland, p. 289,108.

Dubuque, Iowa, p. 36,297.

Dudley, town, Eng., p. 48,809.

Du'isburg, city, Prussia, p. 70,272.

Duluth, Minn., p. 52,969.

Dunaburg (Dvinsk), city, Russia, p. 72,231.

Dundee, city, Scotland, p. 160,871.

Dunfermline (dun-fer'lin), town, Scotland, p. 25,250.

Dunkerque', city, France, p. 39,718.

Durango, state, Mexico, □ 38,009, p. 292,549. — Its * p. 31,092.

Durban', city, Natal, So. Africa, p. 39,245.

Durham, co., Eng., □ 999, p. 833,614.

Dusseldorf, city, Prussia, p. 213,767.

Dutch East Indies, belong to Netherlands, comprise parts of Sumatra, Java, Madura, Riau-Lingga Arch., Banca, Billiton, Borneo, Celebes, Moluccas, Timor, Bali, Lombok, New Guinea, etc., □ 736,400, p. 34,000,000, * Batavia (Java), p. 115,567.

Dutch Guiana, So. Am., □ 46,060, p. 66,490, * Paramaribo, p. 31,200.

E

East Africa, British (inc. E. Africa Protectorate and Uganda Protectorate), □ 1,000,000 (est.).

Easton, Pa., p. 25,238.

East St. Louis, Ill., p. 29,655.

East Turkestan, dep. Chinese Empire, □ 431,800, p. 580,000.

Ecuador, republic of So. Am., □ 120,000, p. 1,270,000, * Quito.

Edinburgh, * Scotland, p. 316,479.

Egypt, prov. under Turkish suzerainty, □ 400,000 (excluding Sudan), p. 9,734,405, * Cairo.

Egyptian Sudan, part of Sudan, So. of 22° N. lat., ruled jointly by Egypt and Great Britain, □ 950,000, p. 10,000,000, * Khartum.

Elberfeld, city, Prussia, p. 156,937.

Elizabeth, N. J., p. 52,130.

Elizabethgrad, city, Russia, p. 61,841.

Elmira, N. Y., p. 35,672.

Erie, Pa., p. 52,733.

Ely, Isle of, Cambridge co., Eng., □ 374, p. 64,499.

England and Wales, □ 58,309, p. 32,526,075.

Erfurt, city, Prussia, p. 78,174.

Eritrea, Africa, Italian colony on Red Sea, □ 88,500 p. 450,000, * Asmara.

Erzerum, city, Armenia, p. 38,900.

Essen, city, Prussia, p. 118,863.

Essex, co., Eng., □ 1,533, p. 816,503.

Ethiopia, ancient name of Abyssinia.

Europe, continent, □ 3,797,410, p. 380,000,000.
 Evansville, Ind., p. 59,007.
 Exeter, town, Eng., p. 46,940.

F

Faiza'bad, city, India, p. 74,076.
 Falkirk, town, Scotland, p. 29,271.
 Falkland Islands, British Crown Colony, So. Atlantic, □ 7,500, p. 1,759, * Stauley, p. 789.
 Fall River, Mass., p. 104,863.
 Farukhabad', city, India, p. 62,878.
 Fayoum', city, Egypt, p. 33,069.
 Federal District, Mexico, □ 463, p. 468,705.
 Ferrara, city, Italy, p. 91,259.
 Ferrol, city, Spain, p. 35,975.
 Fez, * Morocco, p. 140,000.
 Fezzan (ancient Phazania), prov. in So. part of Tripoli, in desert region.
 Fiji Islands, So. Pacific (about 200 islands), British, □ 8,045, p. 122,673, * Suva.
 Finland, grand-duchy, Russia, □ 144,255, p. 2,483,249.
 Fitchburg, Mass., p. 31,531.
 Fium'e, town and prov., Hungary, □ 8, p. 30,000.
 Flint, co., Wales, □ 256, p. 81,490.
 Florence, city, Italy, p. 216,051.
 Florida, So. Atlantic state, □ 58,680, p. 528,542, * Tallahassee.
 Incorporated cities and towns of 1,000 pop. or more in 1900:
 Apalachicola . 3,077 Miami 1,681
 Bartow 1,983 Milton 1,204
 Daytona 1,690 Monticello 1,076
 De Land 1,449 Ocala 3,380
 Fernandina .. 3,245 Orlando 2,481
 Fort Brook... 1,135 Palatka 3,301
 Gainesville .. 3,633 Pensacola 17,747
 High Springs 1,562 Port Tampa Cy. 1,367
 Jacksonville 28,429 St. Augustine.. 4,272
 Key West... 17,114 St. Petersburg.. 1,575
 Kissimmee .. 1,132 Sanford 1,450
 Lake City.... 4,013 Tallahassee ... 2,981
 Lakeland 1,108 Tampa 15,839
 Live Oak.... 1,659 West Tampa.... 2,355
 Foggia (fod'ja), city, Italy, p. 50,374.
 Forlì, city, Italy, p. 47,082.
 Formosa, isl. in China Sea, belongs to Japan, □ 13,458, p. 2,745,138.
 Fort Wayne, Ind., p. 45,115.
 Fort Worth, Texas, p. 26,688.
 France, republic of W. Europe, □ 204,092, p. 38,641,323, * Paris.
 Frankfort-on-Main, city, Prussia, p. 288,489.
 Frankfort-on-Oder, city, Prussia, p. 59,161.
 Franklin, ter. Canada (isls. N. Canada).
 Freetown, * Sierra Leone, p. 30,033.
 Freiburg, city, Baden, Germany, p. 53,118.
 — city, Saxony, p. 29,987.
 French Congo, Fr. posses. on W. coast of Africa, □ 450,000, p. 8,000,000.
 French Guiana, colouy, So. Am., □ 46,850, p. 30,300, * Cayenne, p. 12,300.
 French Guinea, on African coast, □ 95,000, p. 2,200,000, * Konakry.
 French Somali Coast, E. Africa, □ 45,000, p. 22,000, * Jibuti.
 Fu'chau, city, Chiua, on Miu R., p. 650,000.
 Fu'kien, prov., China, □ 41,300, p. 22,191,000.
 Fuku'i, city, Japan, p. 44,286.
 Fukuo'ka, city, Japan, p. 66,190.
 Fula Empire, included in Nigeria, W. Africa.
 Furth, city, Bavaria, Germany, p. 46,777.

G

Ga'latz, city, Rumania, p. 62,678.
 Galicia, prov., Austria, □ 30,307, p. 7,295,538.
 Galle (gawl), city, Ceylon, p. 33,596.
 Gal'veston, Tex., p. 37,789.
 Gambia, British W. Africa, crown colony, □ 69, p. 15,000, * Bathurst, p. 6,000.
 Gateshead, city, Eng., p. 109,887.
 Gaya', city, India, p. 71,186.
 Gefle (yev'la), city, Sweden, p. 28,308.
 Gen'oa (It. Geno'va), city, Italy, p. 237,486.

Geneva, city, Switzerland, p. 104,044.
 Georgetown, * British Guiana, p. 53,176.
 Georgia, So. Atlantic state, □ 59,475, p. 2,216,331, * Atlanta.

Incorporated cities and towns of 1,000 or more in 1900:

Abbeyville ... 1,152	Hawkinsville... 2,103
Albany 4,606	Jackson 1,487
Americus 7,674	La Grange..... 4,274
Ashburn 1,301	Lithonia 1,208
Athens 10,245	Louisville 1,009
Atlanta 89,872	Lumpkin. 1,470
Augusta 39,441	McRae 1,020
Bainbridge .. 2,641	Macon 23,272
Barnesville .. 3,036	Madison 1,992
Blue Ridge.... 1,148	Marietta 4,446
Brunswick ... 9,081	Milledgeville ... 4,219
Buena Vista.. 1,161	Monroe 1,846
Buford 1,352	Monticello 1,106
Camilla 1,051	Moultrie 2,221
Carrollton ... 1,998	Newnan 3,654
Cartersville .. 3,135	Quitman 2,281
Cedartown ... 2,823	Richland 1,014
Cochran 1,531	Rome 7,291
Columbus 17,614	Roswell 1,329
Conyers 1,605	Sandersville ... 2,023
Cordele 3,473	Savannah 54,244
Covington ... 2,062	Seville 1,277
Cuthbert 2,641	Social Circle... 1,229
Dahlonega ... 1,255	Sparta 1,150
Dalton 4,315	Statesboro 1,197
Darien 1,739	Summerville
Dawson 2,926	Richmond co. 3,245
Decatur 1,418	Talbotbottom 1,131
Douglasville . 1,140	Tallapoosa 2,128
Dublin 2,987	Tennille 1,121
Eastman 1,235	Thomaston 1,714
East Point... 1,315	Thomasville ... 5,322
Eatonton 1,823	Thomson 1,154
Edgewood 1,285	Tifton 1,384
Elberton 3,834	Toccoa 2,176
Fitzgerald ... 1,817	Trion 1,926
Forsyth 1,172	Valdosta 5,613
Fort Gaines... 1,305	Vieuna 1,035
Fort Valley... 2,022	Warrenton 1,113
Gainesville ... 4,382	Washington 3,300
Greensboro .. 1,511	Waycross 5,919
Griffin 6,857	Waynesboro 2,030
Harmony	West Point.... 1,797
Grove 1,454	Winder 1,145
Hartwell 1,672	Wrightsville ... 1,127

Gera, * Reuss, Jüngere Linie, Germany, p. 43,544.

Gergenti, city, Italy, p. 25,441.

German East Africa, German dep., □ 384,180, p. 8,000,000, * Bagamoyo, p. 13,000.

German Empire, Europe, □ 208,830, p. 56,345,014, * Berlin.

German South-West Africa, German dep., □ 322,450, p. 200,000, * Great Windhoek.

Ghent, city, Belgium, p. 163,030.

Gibraltar, British crown colony on Mediterranean, □ 1.9, p. 24,701.

Gijon (he-hone'), city, Spain, p. 43,392.

Glamor'gan, co., Wales, □ 790, p. 601,092.

Glasgow, city, Scotland, p. 760,423.

Gloucester, Mass., p. 26,121, — co., Eng., □ 1,236, p. 331,516, — its * p. 47,943.

Goa, Portuguese ter. in India, □ 1,390, p. 494,836, * Panjin.

Gold Coast, British W. Africa, crown colouy, □ 40,000, p. (est.) 1,473,882, * Accra, p. 16,267.

Gorakhpur', city, India, p. 63,059.

Gorlitz, city, Prussia, p. 70,175.

Go'teborg, city, Sweden, p. 126,849.

Gotha (go'ta), * Saxe-Coburg and Gotha, Germany, p. 31,671.

Gov'an, city, Scotland, p. 76,351.

Granada, city, Spain, p. 75,054.

Grand Rapids, Mich., p. 87,565.

Gratz, city, Austria, p. 138,370.

Great Britain and Ireland, see United Kingdom.

Greece, kingdom of Europe, □ 25,014, p. 2,433,806, * Athens.

Greenland, isl., N. E. of No. Am., belongs to Denmark, □ 46,740, p. 10,516.

Greenock, city, Scotland, p. 67,645.
 Greiz, * Reuss, Aeltere Linie, Germany, p. 22,296.
 Grenoble, city, France, p. 64,002.
 Grimsby, town, Eng., p. 63,138.
 Groningen, city, Holland, p. 66,739.
 Guadalajara (—ha'ra), city, Mexico, p. 101,413.
 Guadeloupe, isl., Lesser Antilles, belongs to France, □ 583, p. (with dependencies) 167,000.
 Guam, isl., largest of Ladrões (U. S.), □ 200, p. 9,000, * Agaña, p. 6,000.
 Guanajuato (—hwa'to), state, Mexico, □ 11,370, p. 1,047,817, — its * p. 39,404.
 Guatemala, republic, Cen. Am., □ 48,290, p. 1,574,340, * Guatemala la Nueva, p. 72,102.
 Guayaquil (gwi-a-keel'), city, Ecuador, p. 50,000.
 Guerre'ro, state, Mexico, □ 24,996, p. 417,886.

H

Haarlem, city, Holland, p. 64,836.
 Haidara'bad, state, India, □ 82,698, p. 11,174,897, — its * p. 446,291.
 Haiti, republic, W. part of Isl. of Haiti, □ 10,204, p. 1,210,625, * Port-au-Prince.
 Hakoda'te, city, Japan, p. 78,040.
 Halifax, * prov. Nova Scotia, Canada, p. 40,787, — city, Eng., p. 104,933.
 Halle-on-Saale, city, Prussia, p. 156,611.
 Hamburg, Ger. state and free city, □ 158, p. 768,349.
 Hamilton, city, Canada, p. 52,550. — town, Scotland, p. 32,775.
 Hankow, city, China, on Yangtse R., p. (est.) 800,000.
 Hanley, town, Eng., p. 61,524.
 Hanover, city, Prussia, p. 235,666. — prov. Prussia, p. 2,590,336.
 Harrisburg, * Pa., p. 50,167.
 Hartford, * Conn., p. 79,850.
 Hastings, town, Eng., p. 65,528.
 Havana, * Cuba, p. 235,981.
 Haverhill, Mass., p. 37,175.
 Havre (ha'ver) (or Le Havre) (le-av'r), city, France, p. 129,000.
 Hawaii, group of isles, Pacific Ocean, ter. of U. S., □ 6,449, p. 154,001, * Honolulu, p. 39,306.

Area and population of the inhabited islands:

	Area.	Pop.
Hawaii	4,210	46,843
Kauai and Niihau.....	687	20,734
Lanai and Maui.....	910	25,416
Molokai	270	2,504
Oahu	600	58,504
Kahoolawe	63	.....

Hedjaz, Turkish prov. Arabia, □ 96,500, p. 300,000.
 Heidelberg, city, Baden, Germany, p. 35,190.
 Heilbronn, city, Wurtemberg, Germany, p. 33,461.
 Helsingfors, city, Finland, p. 77,484.
 Herat, city, Afghanistan, p. 40,000.
 Hereford, co., England, □ 840, p. 114,150.
 Hertford, co., Eng., □ 636, p. 258,045.
 Herzegovi'na, see Bosnia.
 Hesse, Ger. Grand-duchy, □ 2,965, p. 1,120,426, * Darmstadt.
 Hidal'go, state, Mex., □ 8,917, p. 551,817.
 Hindustan, Persian name of India, see India.
 Hiroshi'ma, city, Japan, p. 122,306.
 Hobart, * Tasmania, p. 24,905.
 Ho'boken, N. J., p. 59,364.
 Hodmeso-Vazarhely (hod-mey-zo-va-sar-hail'), city, Hungary, p. 60,789.
 Hof, city, Bavaria, Germany, p. 27,556.
 Holland, kingdom, see Netherlands.
 Hol'yoke, Mass., p. 45,712.
 Honan, prov., China, □ 61,300, p. 22,116,000.
 Hondur'as, republic, Cen. Am., □ 46,250, p. 407,000, * Tegucigalpa.
 Hongkong, isl., S. E. coast of China, British crown colony, □ 29, p. 254,400, * Victoria.
 Honolu'lu, * Hawaii, p. 39,306.
 Houston, Tex., p. 44,633.

Howrah, city, India, p. 157,847.
 Hubli, city, India, p. 58,149.
 Huddersfield, city, Eng., p. 95,008.
 Hu'n'an, prov., China, □ 74,400, p. 21,003,000.
 Hungary, kingdom, part of Austria-Hungary, □ 125,039, p. 19,203,531, * Budapest.
 Huntingdon, co., Eng., □ 366, p. 54,127.
 Hu'peh, prov., China, □ 65,900, p. 32,245,000.

I

Iceland, isl., E. of Greenland, belongs to Denmark, □ 39,756, p. 70,927.
 Ichang, city, China, on Yangtse R., p. 35,000.
 Idaho, W. state, □ 84,800, p. 161,772, * Boise.
 Incorporated cities and towns of 1,000 pop. or more in 1900:

Boise	5,957	Moscow	2,484
Grangeville	1,132	Pocatello	4,046
Idaho Falls	1,262	Rexburg	1,081
Lewiston	2,425	Wallace	2,265
Malade	1,050	Weiser	1,364
Montpelier	1,444		

Illinois, No. central state, □ 56,650, p. 4,821,550, * Springfield.
 Incorporated cities and towns of 1,000 pop. or more in 1900:

Abingdon	2,022	Coal City	2,607
Albion	1,162	Cobden	1,034
Aledo	2,081	Colchester	1,535
Altamont	1,335	Colfax	1,153
Alton	14,210	Collinsville	4,021
Amboy	1,826	Columbia	1,197
Anna	2,618	Crotty	1,036
Arcola	1,995	Cuba	1,198
Arlingt'n H'ts	1,380	Danville	16,351
Ashland	1,201	Decatur	20,754
Assumption	1,702	Dekalb	5,904
Astoria	1,684	Delavan	1,304
Athens	1,535	Des Plaines	1,666
Atlanta	1,270	Dixon	7,917
Auburn	1,281	Dolton	1,220
Augusta	1,149	Downer's G've	2,103
Aurora	24,147	Duquoin	4,353
Averyville	1,573	Dwight	2,015
Barrington	1,162	Earlville	1,122
Barry	1,643	E. Dubuque, C	1,146
Batavia	3,871	E. Dubuque, V	1,417
Beardstown	4,827	E. St. Louis	29,655
Belleville	17,484	Edinburg	1,071
Belvidere	6,937	Edwardsville	4,157
Bement	1,484	Effingham	3,774
Benton	1,341	Eldorado	1,445
Bloomington	23,286	Elgin	22,433
Blue Island	6,114	Elmhurst	1,728
Braceville	1,669	Elmwood	1,582
Bradley	1,518	El Paso	1,441
Braidwood	3,279	Eureka	1,661
Breese	1,571	Evanston	19,259
Brooklyn	1,019	Fairbury	2,187
Bunker Hill	1,279	Fairfield	2,338
Bushnell	2,490	Farmer City	1,664
Byron	1,015	Farmington	1,729
Cairo	12,566	Flora	2,311
Cambridge	1,345	Forreston	1,047
Camp Point	1,260	Fort Sheridan	1,575
Canton	6,564	Freeburg	1,214
Carbondale	3,318	Freeport	13,258
Carbon Hill	1,256	Fulton	2,685
Carlinville	3,502	Galena	5,005
Carlyle	1,874	Galesburg	18,607
Carmi	2,939	Galva	2,682
Carpent'sville	1,002	Gardner	1,036
Carrollton	2,355	Geneseo	3,356
Cartersville	1,749	Geneva	2,246
Carthage	2,104	Genoa	1,140
Casey	1,500	Germantown	1,782
Centralia	6,721	Gibson	2,054
Cerro Gordo	1,008	Gilman	1,441
Champaign	9,098	Girard	1,661
Charleston	5,488	Glencoe	1,020
Chatsworth	1,038	Golconda	1,140
Chenoa	1,512	Granite	3,122
Chester	2,832	Grayville	1,948
Chicago	1,398,575	Greenfield	1,085
Chicago H'g'ts	5,100	Greenup	1,085
Chillicothe	1,099	Greenview	1,019
Clinton	4,452	Greenville	2,504

Illinois.—Continued.

Griggsville	1,404	Newton	1,630
Grossdale	1,111	Nilwood	1,378
Hamilton	1,344	Nokomis	1,371
Harlem	4,085	Normal	3,795
Harrisburg	2,202	North Chicago	1,150
Harvard	2,602	North Peoria	2,358
Harvey	5,395	North Utica	1,150
Havana	3,268	Oakland	1,198
Henry	1,637	Odell	1,000
Herrin	1,559	Odin	1,180
Highland	1,970	O'Fallon	1,267
Highland Pk.	2,806	Olney	4,260
Hillsboro	1,937	Onarga	1,270
Hinsdale	2,578	Oquawka	1,010
Homer	1,080	Oregon	1,577
Hoopeston	3,823	Ottawa	10,558
Jacksonville	15,078	Palatine	1,020
Jerseyville	3,517	Pana	5,530
Joliet	29,353	Paris	6,105
Jonesboro	1,130	Park Ridge	1,340
Kangley	1,004	Paxton	3,036
Kankakee	13,595	Pecatonica	1,045
Kansas	1,049	Pekin	8,420
Keithsburg	1,566	Peoria	56,100
Kewanee	8,382	Peotone	1,003
Kinmundy	1,221	Peru	6,863
Kirkwood	1,008	Petersburg	2,807
Knoxville	1,857	Pinckneyville	2,357
Lacon	1,601	Pittsfield	2,293
Ladd	1,324	Plano	1,634
Lagrange	3,969	Polo	1,869
La Harpe	1,591	Pontiac	4,266
Lake Forest	2,215	Princeton	4,023
Lanark	1,306	Prophetstown	1,143
Lasalle	10,446	Quincy	36,252
Lawrenceville	1,300	Rantoul	1,207
Lebanon	1,812	Redbud	1,169
Lemont	2,449	Ridgely	1,169
Lena	1,252	River Forest	1,539
Leroy	1,629	Riverside	1,551
Lewistown	2,504	Riverton	1,511
Lexington	1,415	Robinson	1,683
Lincoln	8,962	Rochelle	2,073
Litchfield	5,918	Rock Falls	2,176
Lockport	2,659	Rockford	31,051
McHenry	1,013	Rock Island	19,493
Mc Leansboro	1,758	Roodhouse	2,351
Macomb	5,375	Roseville	1,014
Madison	1,979	Rossville	1,435
Marengo	2,005	Rushville	2,292
Marion	2,510	St. Anne	1,000
Marissa	1,086	St. Charles	2,675
Maroa	1,213	St. Elmo	1,050
Marseilles	2,559	Salem	1,642
Marshall	2,077	Sandoval	1,258
Martinsville	1,000	Sandwich	2,520
Mascoutah	2,171	Savanna	3,325
Mason City	1,890	Shawneetown	1,698
Mattoon	9,622	Sheffield	1,265
Maywood	4,532	Shelbyville	3,546
Melrose Park	2,592	Sheldon	1,103
Mendota	3,736	Sorento	1,000
Metropolis	4,069	Sparta	2,941
Millford	1,077	Springfield	34,159
Millstadt	1,172	Spring Valley	6,214
Minonk	2,545	Staunton	2,786
Moline	17,248	Sterling	6,309
Momence	2,026	Streator	14,079
Monmouth	7,460	Sullivan	2,399
Monticello	1,982	Sumner	1,268
Morgan Park	2,329	Sycamore	3,653
Morris	4,273	Taylorville	4,248
Morrison	2,308	Toluca	2,629
Mound City	2,705	Toulon	1,057
Mt. Carmel	4,311	Trenton	1,706
Mt. Carroll	1,965	Troy	1,080
Mt. Morris	1,048	Tuscola	2,569
Mt. Olive	2,935	Upper Alton	2,373
Mt. Pulaski	1,643	Urbana	5,728
Mt. Sterling	1,960	Vandalia	2,665
Mt. Vernon	5,216	Venice	2,450
Moweaqua	1,478	Vermont	1,195
Murphysboro	6,463	Vienna	1,217
Naperville	2,629	Virden	2,280
Nashville	2,184	Virginia	1,600
Nauvoo	1,321	Warren	1,327
Neoga	1,126	Warsaw	2,335
Newman	1,166	Washington	1,459

Illinois.—Continued.

Waterloo	2,114	Whitehall	2,030
Watseka	2,505	Wilmette	2,300
Waukegan	9,426	Wilmington	1,420
Waverly	1,573	Winchester	1,711
Wenona	1,486	Winnetka	1,833
West Chicago	1,877	Winstanley	
West Dundee	1,348	Park	1,055
W. Hammond	2,935	Woodstock	2,502
Westville	1,605	Wyoming	1,277
Wheaton	2,345		
India, Asiatic empire, belongs to Great Britain, □ 1,559,603, p. 291,628,307, * Calcutta.			
Indiana, No. central state, □ 36,350, p. 2,516, 462, * Indianapolis.			
Incorporated cities and towns of 1,000 pop. or more in 1900:			
Albany	2,116	Hope	1,088
Albion	1,324	Howell	1,421
Alexandria	7,221	Huntingburg	2,527
Anderson	20,178	Huntington	9,491
Angola	2,141	Indianapolis	169,164
Arcadia	1,413	Irvington	1,799
Argos	1,307	Jasper	1,863
Ashley	1,040	Jeffersonville	10,774
Atlanta	1,000	Jonesboro	1,838
Attica	3,005	Kendallville	3,354
Auburn	3,396	Kentland	1,006
Aurora	3,645	Knightstown	1,942
Batesville	1,384	Knightsville	1,171
Bedford	6,115	Knox	1,466
Bern	1,037	Kokomo	10,609
Bloomfield	1,588	Ladoga	1,176
Bloomington	6,460	Lafayette	18,116
Bluffton	4,479	Lagrange	1,703
Boonville	2,849	Laporte	7,113
Bourbon	1,187	Lawrenceburg	4,326
Brazil	7,786	Lebanon	4,465
Bremen	1,671	Liberty	1,449
Brookville	2,037	Ligonier	2,231
Brownstown	1,685	Linton	3,071
Butler	2,063	Logansport	16,204
Cambridge		Loogootee	1,382
City	1,754	Lowell	1,275
Cannelton	2,188	Madison	7,835
Carthage	1,028	Marion	17,337
Cicero	1,603	Martinsville	4,038
Clarksburg	2,370	Michigan City	14,850
Clay City	1,503	Middletown	1,801
Clinton	2,918	Mishawaka	5,560
Columbia City	2,975	Mitchell	1,772
Columbus	8,130	Monon	1,160
Connorsville	6,836	Montezuma	1,172
Converse	1,415	Monticello	2,107
Corydon	1,610	Montpelier	3,405
Covington	2,213	Mt. Vernon	5,132
Crawfordsville	6,649	Muncie	20,942
Crown Point	2,336	Nappanee	2,208
Danville	1,802	New Albany	20,628
Decatur	4,142	Newburg	1,371
Delphi	2,135	New Castle	3,406
Dunkirk	3,187	New Harmony	1,341
East Chicago	3,411	Noblesville	4,792
Eaton	1,567	North	
Edinburg	1,820	Manchester	2,398
Elkhart	15,184	North Vernon	2,823
Elwood	12,950	Oakland	1,991
Evansville	59,007	Orleans	1,236
Fairmount	3,205	Osgood	1,035
Flora	1,209	Owensville	1,019
Fortville	1,006	Paoli	1,186
Fort Wayne	45,115	Pendleton	1,512
Fowler	1,429	Peru	8,463
Frankfort	7,100	Petersburg	1,751
Franklin	4,005	Plymouth	3,656
Frankton	1,464	Port Fulton	1,101
Garrett	3,910	Portland	4,798
Gas City	3,622	Princeton	6,041
Geneva	1,076	Redkey	2,206
Goodland	1,205	Remington	1,120
Goshen	7,810	Rensselaer	2,255
Greencastle	3,661	Richmond	18,226
Greenfield	4,489	Ridgeville	1,098
Greensburg	5,034	Rising Sun	1,548
Greentown	1,287	Rochester	3,421
Greenwood	1,503	Rockport	2,882
Hammond	12,376	Rockville	2,045
Hartford	5,912	Rushville	4,541
Hobart	1,390	Salem	1,995

Indiana.—Continued.

Scottsburg	....1,244	Valparaiso	....6,280
Seymour	....6,445	Veedersburg	....1,638
Shelbyville	....7,169	Vevay	....1,588
Sheridau	....1,795	Vincennes	....10,249
South Bend	....35,999	Wabash	....8,618
South Whitley	....1,113	Walkerton	....1,037
Spencer	....2,026	Warren	....1,523
Sullivan	....3,118	Warsaw	....3,987
Summitville	....1,432	Washington	....8,551
Swayzee	....1,162	Waterloo	....1,244
Tell City	....2,680	W. Lafayette	....2,302
Terre Haute	....36,673	Whiting	....3,983
Thorutown	....1,511	Williamsport	....1,245
Tipton	....3,764	Winamac	....1,684
Union City	....2,716	Winchester	....3,705
Upland	....1,208	Worthington	....1,448

Indian Territory, So. central part of U. S.,

□ 31,400, p. 392,060.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ardmore	....5,681	Pauls Valley	....1,467
Chickasha	....3,209	Poteau	....1,182
Coalgate	....2,614	Purcell	....2,277
Davis	....1,343	So. McAlester	....3,479
Duncan	....1,164	Sulphur Spgs.	....1,198
Durant	....2,969	Tahlequah	....1,482
Hartshorne	....2,352	Tulsa	....1,390
Lehigh	....1,500	Vinita	....2,339
Marlow	....1,016	Wagoner	....2,372
Miami	....1,527	Wynnewood	....1,907
Muscogee	....4,254		

Iowa, No. central state, □ 56,025, p. 2,231,-853, * Des Moines.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ackley	....1,445	Eagle Grove	....3,557
Adel	....1,213	Eddyville	....1,230
Afton	....1,178	Eldon	....1,850
Akron	....1,029	Eldora	....2,233
Albia	....2,889	Elkader	....1,321
Algona	....2,911	Emmetsburg	....2,361
Alton	....1,009	Estherville	....3,237
Ames	....2,422	Fairfield	....4,689
Anamosa	....2,891	Farmington	....1,332
Atlantic	....5,046	Fayette	....1,315
Audubon	....1,866	Fonda	....1,180
Avoca	....1,627	Forest City	....1,758
Bedford	....1,977	Fort Dodge	....12,162
Belle Plaine	....3,283	Fort Madison	....9,278
Bellevue	....1,607	Garner	....1,288
Belmond	....1,234	Glenwood	....3,040
Bloomfield	....2,105	Grand Junction	....1,113
Boone	....8,880	Green	....1,192
Britt	....1,540	Greensfield	....1,300
Brooklyn	....1,188	Grinnell	....3,860
Burlington	....23,201	Grundy Center	....1,322
Calmar	....1,003	Guthrie Center	....1,193
Carroll	....2,882	Guttenberg	....1,620
Cascade	....1,266	Hamburg	....2,079
Cedar Falls	....5,319	Hampton	....2,727
Cedar Rapids	....25,656	Harlan	....2,422
Centerville	....5,256	Hartley	....1,006
Charitou	....3,989	Hawarden	....1,810
Charles City	....4,227	Hedrick	....1,035
Cherokee	....3,865	Humboldt	....1,474
Cincinnati	....1,212	Ida Grove	....1,967
Clarinda	....3,276	Independence	....3,656
Clarion	....1,475	Indianola	....3,261
Clear Lake	....1,706	Iowa City	....7,987
Clinton	....22,698	Iowa Falls	....2,840
Colfax	....2,053	Jefferson	....2,601
Columbus		Keokuk	....14,641
Junction	....1,099	Keosauqua	....1,117
Coon Rapids	....1,017	Knoxville	....3,131
Corning	....2,145	Lake City	....2,703
Corydon	....1,477	Lake Mills	....1,293
Council Bluffs	....25,802	Lamoni	....1,540
Cresco	....2,806	Lansing	....1,433
Creston	....7,752	Laporte	....1,419
Davenport	....35,254	Le Mars	....4,146
Decorah	....3,246	Lenox	....1,014
Denison	....2,771	Leon	....1,905
Des Moines	....62,139	Logan	....1,377
Dewitt	....1,383	Lucas	....1,132
Dubuque	....36,297	McGregor	....1,498
Dunlap	....1,355	Madrid	....1,021
Dyersville	....1,323		

Iowa.—Continued.

Malvern	....1,166	Rockwell City	....1,222
Manchester	....2,887	Sabula	....1,029
Manning	....1,169	Sac City	....2,079
Manson	....1,424	Sanboru	....1,247
Mapleton	....1,099	Seymour	....1,703
Maquoketa	....3,777	Sheldon	....2,282
Marengo	....2,007	Shenandoah	....3,573
Marion	....4,102	Sibley	....1,289
Marshalltown	....11,544	Sidney	....1,143
Mason City	....6,746	Sigourney	....1,952
Missouri		Sioux City	....33,111
Valley	....4,010	Sioux Rapids	....1,005
Montezuma	....1,210	Spencer	....3,095
Monticello	....2,104	Spirit Lake	....1,219
Moulton	....1,420	State Center	....1,008
Mt. Ayr	....1,729	Storm Lake	....2,169
Mt. Pleasant	....4,109	Story City	....1,197
Mt. Vernon	....1,629	Strawberry Point	....1,012
Muscatine	....14,073	Stuart	....2,079
Mystic	....1,758	Sumner	....1,437
Nashua	....1,268	Tama	....2,649
Nevada	....2,472	Tipton	....2,513
New Hampton	....2,339	Toledo	....1,941
New London	....1,003	Traer	....1,458
New Sharon	....1,252	Valley Junction	....1,700
Newton	....3,682	Villisca	....2,211
Nora Springs	....1,209	Vinton	....3,499
Northwood	....1,271	Wapello	....1,398
Odebolt	....1,432	Washington	....4,255
Oelwein	....5,142	Waterloo	....12,580
Onawa	....1,933	Waukon	....2,153
Orange City	....1,457	Waverly	....3,177
Osage	....2,734	Webster City	....4,613
Osceola	....2,505	W. Burlington	....1,044
Oskaloosa	....9,212	West Liberty	....1,690
Ottumwa	....18,197	West Union	....1,935
Parkersburg	....1,164	What Cheer	....2,746
Pella	....2,623	Williamsburg	....1,100
Perry	....3,986	Wilton	....1,233
Red Oak	....4,355	Winterset	....3,039
Reinbeck	....1,203	Woodbine	....1,255
Rockford	....1,080		
Rock Rapids	....1,766		
Rock Valley	....1,054		

Ipswich, town, Eng., p. 66,622.

Iquique (e-ke'kay), city, Chile, p. 38,852.

Ireland, one of British Isles, □ 32,583, p. 4,-456,546, * Dublin.

Irkutsk', city, Siberia, p. 51,484.

Isle of Wight, Southampton co., So. coast of Eng., □ 146, p. 82,388.

Ispahan', city, Persia, p. 80,000.

Italian Somali-Land, Africa, protectorate, □ 100,000, p. 400,000.

Italy, kingdom of So. Europe, □ 110,646, p. 32,449,754, * Rome.

Ivano'vo-Voznesensk', city, Russia, p. 53,949.

Ivory Coast, Africa, E. of Liberia, Fr. posses., □ 125,000, p. 2,500,000, * Grand Bassam.

J

Jabal'pur, city, India, p. 89,708.

Jackson, Mich., p. 25,180.

Jacksonville, Fla., p. 28,429.

Jaffna, city, Ceylon, p. 43,179.

Jaipur, city, India, p. 159,550.

Jalisco, state, Mexico, □ 31,846, p. 1,094,569.

Jamaica, Brit. W. Indies, 90 miles So. of Cuba, □ 4,200, p. 745,104, * Kingston, p. 46,542.

Japan, isl. empire, E. of Japan sea, Asia, □ 147,655 (with Formosa and Pescadores Isl., □ 161,198), p. 43,760,815 (with above islands, 43,558,358), * Tokyo.

Jassy, city, Rumania, p. 78,067.

Java, isl., Dutch E. Indies, □ 49,224, p. 26,-125,000, * Batavia.

Jeres (ha'reth), city, Spain, p. 60,004.

Jersey City, N. J., p. 206,433.

Jerusalem, city, Syria, p. 42,000.

Jhan'si, city, India, p. 55,288.

Jodhpur (jodh'-), city, India, p. 60,437.

Johan'nesburg, city, Transvaal, p. 102,078.

Johnstown, Pa., p. 35,936.

Johore', state, Malay pen. (British), □ 9,000, p. 200,000, * Johore Bahru.

Joliet, Ill., p. 29,353.
 Joplin, Mo., p. 26,023.
 Jungaria, depend. Chinese Empire, □ 147,-
 950, p. 600,000.

K

Ka'bul, * Afghanistan, on Kabul R., p.
 70,000.

Kagoshima, city, Japan, p. 53,481.

Kaisarieh, city, Asia Minor, p. 72,000.

Kaiserslautern, city, Bavaria, Germany, p.
 40,828.

Kaiser Wilhelm's Land, No. section of S. E.
 N. Guinea, German protectorate, □ 70,-
 000, p. 110,000.

Kalat, * Baluchistan.

Kamerun, Africa, German depend., □ 191,-
 130, p. 3,500,000, * Kamerun.

Kanazawa, city, Japan, p. 83,595.

Kansas, No. central state, □ 82,080, p. 1,-
 470,495, * Topeka.

Incorporated cities and towns of 1,000 pop.
 or more in 1900:

Abilene	3,507	Kingman	1,785
Anthony	1,179	Lacygne	1,037
Argentine	5,878	Larned	1,583
Arkansas City	6,140	Lawrence	10,862
Atchison	15,722	Leavenworth	20,735
Augusta	1,197	Lincoln	1,262
Baldwin	1,017	Lindsborg	1,249
Baxter Spgs.	1,641	Lyndon	1,004
Belleville	1,833	Lyons	1,736
Beloit	2,359	McPherson	2,996
Blue Rapids	1,100	Manhattan	3,438
Burlingame	1,436	Marion	1,824
Burlington	2,418	Marysville	2,006
Caldwell	1,574	Minneapolis	1,727
Chanute	4,208	Neodesha	1,772
Cherokee	1,326	Newton	6,208
Cherryvale	3,472	Nickerson	1,038
Chetopa	2,019	Norton	1,202
Clay Center	3,069	Olathe	3,451
Clyde	1,157	Osage	2,792
Coffeyville	4,953	Osawatimie	4,191
Columbus	2,310	Osborne	1,075
Concordia	3,401	Oswego	2,208
Council Grove	2,265	Ottawa	6,934
Dodge	1,942	Paola	3,144
Eldorado	3,466	Parsons	7,682
Ellsworth	1,549	Peabody	1,369
Emporia	8,223	Phillipsburg	1,008
Empire	2,258	Pittsburg	10,112
Erie	1,111	Pleasanton	1,097
Eureka	2,091	Pratt	1,213
Florence	1,178	Rosedale	3,270
Fort Scott	10,322	Russell	1,143
Frankfort	1,167	Sabetha	1,646
Fredonia	1,650	St. Marys	1,390
Frontenac	1,805	St. Paul	1,047
Galena	10,155	Salina	6,074
Garden	1,590	Scammon	1,549
Garnett	2,078	Scranton	1,099
Girard	2,473	Sedan	1,067
Goodland	1,059	Seneca	1,846
Great Bend	2,470	Smith Center	1,142
Harper	1,151	Stafford	1,068
Hays	1,136	Sterling	2,002
Herington	1,607	Stockton	1,030
Hiawatha	2,829	Strong	1,128
Holton	3,082	Topeka	33,608
Hor on	3,398	Valley Falls	1,078
Howard	1,207	Wamego	1,618
Humboldt	1,402	Washington	1,575
Hutchinson	9,379	Weir	2,977
Independence	4,851	Wellington	4,245
Iola	5,791	Wichita	24,671
Junction	4,695	Winfield	5,554
Kansas City	51,418	Yates Center	1,634

Kansas City, Mo., p. 163,752.—Kans., p. 51,-
 418.

Kansu, prov., China, □ 131,000, p. 9,285,000.

Karachi, city, India, p. 115,407.

Karlsruhe, city, Baden, Germany, p. 84,030.

Kashmir, state, India, □ 80,000, p. 2,906,173.

Kassel, city, Prussia, p. 106,928.

Katmandu, * Nepal, p. 50,000.

Kazan, city, Russia, p. 131,508.

Keckskemet, city, Hungary, p. 56,951.

Keewatin, ter., Canada, □ 756,000.

Kena, city, Egypt, p. 27,478.

Kent, co., England, □ 1,519, p. 936,003.

Kentucky, So. central state, □ 40,400, p. 2,-
 147,174, * Frankfort.

Incorporated cities and towns of 1,000 pop.
 or more in 1900:

Ashland	6,800	Lawrenceburg	1,253
Augusta	1,718	Lebanon	3,043
Barbourville	1,010	Lexington	26,369
Bardstown	1,711	London	1,147
Bardwell	1,512	Louisa	1,099
Bellevue	6,332	Louisville	204,731
Bowling Gr'n	8,226	Ludlow	3,334
Campbells'le	1,341	Madisonville	3,628
Carlisle	1,377	Marion	1,064
Carrollton	2,205	Mayfield	4,081
Catlettsburg	3,081	Maysville	6,423
Central City	1,348	Middleboro	4,162
C'n'l Cov'gt'n	2,155	Midway	1,045
Clinton	1,462	Morehead	1,100
Cloverport	1,656	Morgantown	2,046
Columbus	1,235	Mt. Sterling	3,561
Corbin	1,544	Mt. Wash'gt'n	1,093
Covington	42,938	Murray	1,822
Cynthiana	3,257	Newport	28,301
Danville	4,285	Nicholasville	2,393
Dayton	6,104	Owensboro	13,189
Earlington	3,012	Owenton	1,014
Eddyville	1,210	Paducah	19,446
Elizabethtown	1,861	Paris	4,603
Elkton	1,123	Pineville	2,072
Eminence	1,018	Princeton	2,556
Falmouth	1,134	Providence	1,286
Flemingsburg	1,268	Richmond	4,653
Frankfort	9,487	Russellville	2,591
Franklin	2,166	Seabree	1,477
Fulton	2,860	Shelbyville	3,016
Georgetown	3,823	Somerset	3,384
Glasgow	2,019	Springfield	1,016
Greenville	1,051	Stanford	1,651
Harrodsburg	2,876	Sturgis	1,258
Hawesville	1,041	Uniontown	1,532
Henderson	10,272	Vanceburg	1,161
Hickman	1,589	Versailles	2,337
Hopkinsville	7,280	West Cov'gt'n	1,606
Lancaster	1,640	Williamsburg	1,495
Latonia	1,882	Winchester	5,964

Kerbela, city, Mesopotamia, Asia, p. 65,000.

Kerman, city, Persia, p. 45,000.

Kharkov, city, Russia, p. 174,846.

Khartum, * Egyptian Sudan.

Kherson, city, Russia, p. 69,219.

Khiva, Rus. vassal state, Asia, □ 22,320,
 p. 800,000, * Khiva, p. 5,000.

Khurdistan, see Armenia.

Kiangsi, prov. China, □ 67,500, p. 24,534,000.

Kiangsu, prov. China, □ 36,900, p. 20,905,000.

Kiau-Chau, district of Shan-Tung, China,
 seized by Germany in 1897, □ 200, p.
 60,000.

Kiel, city, Prussia, p. 107,938.

Kiev, city, Russia, p. 247,432.

Kilmarnock, town, Scotland, p. 34,161.

Kimberley, city, Cape Colony, p. 28,718.

Kingston, * Jamaica, p. 46,542.

Kingston-upon-Hull, city, England, p. 240,618.

Kio'to, city, Japan, p. 353,139.

Kirkcaldy, town, Scotland, p. 34,064.

Kishinev, city, Russia, p. 108,796.

Kiukiang, city, China, on Yangtse R., p.
 55,000.

Knoxville, Tenn., p. 32,637.

Kobe, city, Japan, p. 215,780.

Kokand, city, Rus. Turkestan, p. 82,054.

Kongo Free State, same as Congo.

Koniah, city, Asia Minor, p. 44,000.

Konigsberg, city, Prussia, p. 187,897.

Korea, kingdom of E. Asia, □ 82,000, p.
 est. 10,000,000, * Seoul, p. 201,000.

Kovno, city, Russia, p. 73,543.

Krakau, see Cracow.

Krefeld, city, Prussia, p. 106,928.

Kremenchug, city, Russia, p. 58,648.

Kumamoto, city, Japan, p. 61,463.

Kuria Muria, five islands off So. coast Arabia
 (British).

Kursk, city, Russia, p. 52,896.
 Kwangsi, prov. China, □ 80,100, p. 5,181,000.
 Kwangtung, prov. China (with Hainan Isl.).
 □ 79,456, p. 29,706,000.
 Kwang-Tung, prov. of E. China, leased to
 Russia in 1895 for 25 years. * Port Arthur.
 Kweichau, prov. China, □ 58,000, p. 7,669,000.

L

Labrador, ter. on coast No. of Newfoundland,
 dep. of Newfoundland, □ 120,000, p. 3,634.
 Labuan', isl. No. of Borneo, British crown
 colony, □ 30, p. 5,853. * Victoria, p. 1,500.
 La Crosse, Wis., p. 28,895.
 Lagos, Brit. W. Africa, crown colony, □ 985,
 p. 85,607. — Also Protectorate, □ 21,000,
 p. 3,000,000.
 Lahore', city, India, p. 120,058.
 Lancaster, Pa., p. 41,459. — co. Eng., □ 1,757,
 p. 1,827,390.
 La'os, Fr. Posses. Indo China, □ 91,000, p.
 1,500,000, * Luang Prabang.
 La Paz, city, Bolivia, p. 62,320.
 La Plata, city, Argentine Republic, p. 45,410.
 Las Palmas, city, Spain, p. 34,770.
 Lausanne', city, Switzerland, p. 55,973.
 Lawrence, Mass., p. 62,559.
 Lebanon, privileged prov. Syria, □ 2,509, p.
 399,500.
 Lecce, city, Italy, p. 33,118.
 Le Creusot, city, France, p. 32,031.
 Leeds, city, Eng., p. 428,953.
 Leeward Islands, British West Indies, S. E.
 of Porto Rico, □ 701, p. 127,723, * St. John,
 Antigua Isl., p. 9,738.
 Leghorn, city, Italy, p. 105,767.
 Le Havre, city, France, p. 129,000.
 Leicester (les'ter), co. Eng., □ 813, p. 225.-
 896. — Its * p. 211,574.
 Leiden, city, Holland, p. 53,640.
 Leignitz, city, Prussia, p. 51,518.
 Leinster, prov. Ireland (inc. Carlow, Dublin,
 Kildare, Kilkenny, King's, Longford,
 Louth, Meath, Queen's, Westmeath, Wex-
 ford and Wicklow counties), □ 7,622, p.
 1,150,485.
 Leipsic (Leipzig), * Saxony, Germany, p.
 455,089.
 Leith, city, Scotland, p. 76,667.
 Le Mans, city, France, p. 69,075.
 Lemberg, city, Austria, p. 159,618.
 Leon, city, Mexico, p. 58,426. — city, Nicara-
 gua, p. 35,000.
 Levallois-Perret, city, France, p. 47,315.
 Lexington, Ky., p. 26,369.
 Leyte, isl., Philippines, □ 3,800.
 Libau, city, Russia, p. 64,565.
 Liberia, Negro republic, W. Africa, □ 25,000,
 p. 2,060,000.
 Liechtenstein, principality on Rhine R., □
 65, p. 9,434, * Vaduz.
 Liege, city, Belgium, p. 171,031.
 Lille, city, France, p. 215,400.
 Lima, * Peru, p. 100,000.
 Limerick, city, Ireland, p. 38,085.
 Limoges (le-mozh'), city, France, p. 77,703.
 Linares, city, Spain, p. 35,233.
 Lincoln, * Neb., p. 40,169. — co., Eng. (inc.
 Holland, Kesteven and Lindsay), □ 2,638,
 p. 388,038. — its * p. 48,784.
 Linz, city, Austria, p. 47,560.
 Lippe, Ger. principality, □ 469, p. 139,238,
 * Detmold, p. 11,232.
 Lisbon, * Portugal, p. 301,206.
 Little Rock, * Ark., p. 38,307.
 Liverpool, city, Eng., p. 684,947.
 Lodz, city, Poland, Russia, p. 315,209.
 London, * England and British Empire, and
 administrative county, □ 118, p. 4,536,063.
 — city, Canada, p. 37,983.
 Londonderry, city, Ireland, p. 39,873.
 Lorca, city, Spain, p. 59,624.
 Lorient, city, France, p. 41,894.
 Los Angeles, Cal., p. 102,479.
 Louisiana, So. Central state, □ 48,720, p.
 1,381,625. * Baton Rouge.
 Incorporated cities and towns of 1,000 pop.
 or more in 1900:

Louisiana.—Continued.

Abbeville1,536
 Alexandria5,648
 Amite1,547
 Baton Rouge 11,269
 Covington1,205
 Crowley4,214
 Donaldsonv'le 4,105
 Franklin2,692
 Hammond1,511
 Homer1,157
 Houma3,212
 Jackson2,012
 Jeanerette1,905
 Jennings1,539
 Kenner1,253
 Kentwood1,313
 Lafayette3,314
 Lake Charles..6,680
 L'ke Provid'ce 1,256
 Leesville1 148
 Louisville, Ky., p. 204,731.
 Louvain, city, Belgium, p. 42,100.
 Lowell, Mass., p. 94,969.
 Lower Austria, prov., Austria, □ 7,654, p.
 3,086,382.
 Lower California, ter. Mex., □ 58,328, p.
 41,838.
 Lubeck, German Free city, □ 115, p. 96,775,
 p. city proper, 69,874.
 Lublin, city, Poland Russia, p. 50,152.
 Lucca, city, Italy, p. 81,644.
 Lucerne', city, Switzerland, p. 29,115.
 Lucknow, city, India, p. 263,951.
 Ludwigshafen, city, Bavaria, Germany, p.
 29,799.
 Luxemburg, grand duchy, E. of Belgium, □
 998, p. 217,583, * Luxemburg, p. 19,909.
 Luzon', largest isl. of Philippines, □ 44,000.
 Lynn, Mass., p. 68,513.
 Lyon, city, France, p. 453,100.

M

Macao, Portuguese col., isl., mouth of Can-
 ton R., China, □ 4, p. 78,627. — city on isl.
 McKeesport, Pa., p. 34,227.
 Mackenzie, ter., Canada, □ 198,300.
 Madagascar, isl., E. of So. Africa, Fr. Pro-
 tectorate, □ 227,750, p. 2,250,000, * Anta-
 nanarivo, p. 260,000.
 Madras, prov. British India, □ 141,189, p.
 38,208,609, * Madras, p. 509,397.
 Madras States, British India, □ 9,891, p.
 4,190,322.
 Madrid, * Spain, p. 512,150.
 Madura, city, India, p. 105,501.
 Magdeburg, city, Prussia, p. 229,663.
 Maine, N. Atlantic state, □ 33,040, p. 694,466,
 * Augusta.
 Incorporated cities and towns of 1,000 or
 more in 1900:
 Auburn12,951
 Augusta11,683
 Bangor21,850
 Bath10,477
 Belfast4,615
 Biddeford16,145
 Brewer4,835
 Bridgton1,552
 Brunswick5,210
 Calais7,655
 Eastport5,311
 Ellsworth4,297
 Fairfield2,238
 Farmington ..1,251
 Fort Fairfield.1,469
 Gardiner5,501
 Hallowell2,714
 Lewiston23,761
 Madison1,850
 Norway2,934
 Old Town.....5,763
 Pittsfield2,208
 Portland50,145
 Presque Isle..1,256
 Rockland8,150
 Rumford Falls.2,595
 Saco6,122
 Skowhegan4,266
 South Paris..1,457
 So. Portland..6,287
 Waterville9,477
 Westbrook7,283
 Mainz (Mayence), city, Hesse, Germany, p.
 76,946.
 Malaga, city, Spain, p. 125,579.
 Malden, Mass., p. 33,664.
 Maldiv Islands, 17 coral islets, 500 mi. W.
 of Ceylon (British), p. 30,000.
 Malmo, city, Sweden, p. 59,714.
 Malta, isl. in Mediterranean (British), □ 95,
 p. 181,648, * Valetta.
 Managua, * Nicaragua, p. 25,000.

Manchester, N. H., p. 56,987. — city, Eng., p. 543,969.

Manchuria, depend., Chinese Empire, □ 362,-310, p. 7,500,000, * Tsitsihar.

Mandalay, city, India, p. 182,498.

Manila, * Philippine Isls., p. 350,000.

Manitoba, prov., Canada, □ 73,956, p. 246,464, * Winnipeg.

Mannheim, * Baden, Germany, p. 140,384.

Mansou'rah, city, Egypt, p. 36,131.

Mantua, city, Italy, p. 30,217.

Maracaibo, city, Venezuela, p. 34,284.

Maranha'o, city, Brazil, p. 29,308.

Marianne (or Ladrone) Islands, group in No. Pacific, belong to Germany except Guam (U. S.).

Marseilles, city, France, p. 494,800.

Marshall Islands, group in No. Pacific, belong to Germany, □ 150, p. 15,000.

Martinique, Fr., island colony in West Indies, □ 381, p. 187,692, * Fort de France.

Maryland, So. Atlantic state, □ 12,210, p. 1,188,044, * Annapolis.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Annapolis ....8,525	Havre de Grace 3,423
Baltimore ...508,957	Hyattsville ...1,222
Berlin .....1,246	Laurel .....2,079
Brunswick ....2,471	Lonaconing ...2,181
Cambridge ...5,747	Oakland .....1,170
Centerville ...1,231	Oxford .....1,243
Chesapeake ...1,172	Pocomoke City 2,124
Chestertown ..3,008	Fort Deposit..1,575
Crisfield .....3,165	Rockville .....1,110
Cumberland ..17,128	St. Michaels..1,043
Easton .....3,074	Salisbury ....4,277
Elkton .....2,542	Sharpsburg ...1,030
Ellicott City..1,331	Snow Hill....1,596
Frederick ....9,296	Westerport ...1,998
Frostburg ....5,274	Westminister..3,199
Hagerstown ..13,591	Williamsport .1,472

Masba'te, isl., Philippines, □ 1,400.

Mashonaland, pt. of So. Rhodesia, So. Africa, British, □ 92,000, p. 305,000, * Salisbury.

Massa, city, Italy, p. 26,897.

Massachusetts, No. Atlantic state, □ 8,315, p. 2,805,346, * Boston.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Beverly .....13,884	Medford .....18,244
Boston .....560,892	Melrose .....12,962
Brockton ....40,063	New Bedford 62,442
Cambridge ...91,886	Newburyport 14,478
Chelsea .....34,072	Newton .....33,587
Chicopee .....19,167	North Adams 24,200
Everett .....24,336	Northampton 18,643
Fall River...104,863	Pittsfield ....21,766
Fitchburg ...31,531	Quincy .....23,899
Gloucester ...26,121	Salem .....35,956
Haverhill ...37,175	Somerville ...61,643
Holyoke .....45,712	Springfield ..62,059
Lawrence ....62,559	Taunton .....31,036
Lowell .....94,969	Waltham ....23,481
Lynn .....68,513	Woburn .....14,254
Malden .....33,664	Worcester ...118,421
Mari'boro ...13,609	

Matabeleland, pt. of So. Rhodesia, So. Africa, British, □ 100,000, p. 156,835, * Salisbury.

Matanzas, city, Cuba, p. 36,375.

Mauritius, isl., in Indian Ocean, British Colony, □ 705, p. 371,655.

Mayotte, isl. on E. coast of Africa, belongs to France, □ 140, p. 11,610.

Mecca, * Hedjaz, Arabia, p. 60,000.

Mechlin, city, Belgium, p. 55,530.

Mecklenburg-Strelitz, Ger. grand-duchy, □ 1,131, p. 102,628, * Neu Strelitz, p. 10,343.

Mecklenburg-Schwerin, Ger. grand-duchy, □ 5,135, p. 607,835, * Schwerin.

Medellin, city, Colombia, p. 40,000.

Medineh (or Medina), city, Arabia, p. 48,000.

Meerut, city, India, p. 116,642.

Meiningen, * Saxe-Meiningen, Germany, p. 12,869.

Melbourne, * Victoria, Australia, p. 494,129.

Memph's, Tenn., p. 102,320.

Mendoza, city, Argentine Rep., p. 28,709.

Mer'ida, city, Mexico, p. 36,935.

Merioneth, co., Wales, □ 668, p. 48,774.

Meshed, city, Persia, p. 60,000.

Mesopotamia, Turkish prov., Asia, □ 100,205, p. 1,350,300.

Messina, city, Italy, p. 156,552.

Metz, city, Alsace-Lorraine, Germany, p. 59,794.

Mexico, Am. Republic, □ 767,005, p. 13,545,462, * Mexico, p. 368,777. — state, Mexico, □ 9,247, p. 837,981.

Michigan, No. Central state, □ 58,915, p. 2,420,982, * Lansing.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Adrian .....9,654	Howard City..1,398
Albion .....4,519	Howell .....2,518
Algonac .....1,216	Hudson .....2,403
Allegan .....2,667	Imlay City...1,122
Alma .....2,047	Ionia .....5,209
Alpena .....11,802	Iron Mountain 9,242
Ann Arbor...14,509	Iron River...1,482
Au Sable....1,116	Ironwood ....9,705
Baldwin ....1,241	Ishpeming ...13,255
Bangor .....1,021	Ithaca .....2,020
Baraga .....1,185	Jackson .....25,180
Battle Creek..18,563	Jonesville ...1,367
Bay City.....27,628	Kalamazoo ...24,404
Belding .....3,282	Kalkaska ....1,304
Bellaire .....1,157	Lake Linden..2,597
Bellevue .....1,074	Lake Odessa..1,037
Benton H'bor.6,562	Lansing .....16,485
Bessemer ....3,911	Lapeer .....3,297
Big Rapids...4,686	Laurium .....5,643
Birmingham .1,170	Leslie .....1,114
Blissfield ....1,268	Lowell .....1,736
Bronson .....1,176	Ludington ...7,166
Buchanan ....1,708	Mancelona ...1,226
Cadillac .....5,997	Manchester ...1,209
Caro .....2,006	Manistee ....14,260
Cass City....1,113	Manistique ...4,126
Cassopolis ...1,330	Marcellus ....1,025
Central Lake..1,307	Marine City...3,829
Charlevoix ...2,079	Marquette ...10,058
Charlotte ....4,092	Marshall .....4,370
Cheboygan ...6,489	Mason .....1,828
Chelsea .....1,635	Menominee ...12,818
Chesaning ...1,244	Midland .....2,363
Clare .....1,326	Milan .....1,141
Clinton .....1,038	Milford .....1,108
Coldwater ...6,216	Monroe .....5,043
Coleman .....1,014	Morenci .....1,334
Constantine ...1,226	Mt. Clemens..6,576
Corunna .....1,510	Mt. Pleasant..3,662
Crystal Falls.3,231	Munising ....2,014
Decatur .....1,356	Muskegon ....20,818
Delray .....4,573	Muskegon
Detroit .....285,704	Heights .....1,012
Dowagiac ....4,151	Nashville .....1,164
Dundee .....1,118	Negaunee ....6,935
Durand .....2,134	Newaygo .....1,172
East Jordan..1,205	Newberry ....1,015
East Tawas...1,736	Niles .....4,287
Eaton Rapids.2,103	Northville ...1,755
Escanaba ....9,549	Norway .....4,170
Essexville ...1,639	Onaway .....1,204
Evart .....1,360	On'onaon ....1,267
Fenton .....2,408	Oscoda .....1,109
Flint .....13,103	Otsego .....2,073
Frankfort ...1,465	Ovid .....1,293
Freemont ....1,331	Owosso .....8,696
Gaylord .....1,561	Oxford .....1,172
Gladstone ...3,380	Paw Paw.....1,465
Grand Haven..4,743	Pentwater ...1,061
Grand Ledge..2,161	Petoskey ....5,285
Grand Rapids 87,565	Plainwell ....1,318
Greenville ...3,381	Plymouth ....1,474
Hancock .....4,050	Pontiac .....9,769
Harbor Beach 1,149	Port Huron..19,158
Harbor	Portland ....1,874
Springs .....1,643	Quincy .....1,563
Hart .....1,134	Reading .....1,096
Hartford ....1,077	Red Jacket...4,668
Hastings .....3,172	Reed City....2,051
Hillsdale ....4,151	Richmond ....1,133
Holland .....7,790	River Rouge..1,748
Holly .....1,419	Rochester ...1,535
Homer .....1,097	Romeo .....1,580
Houghton ....3,359	Saginaw .....42,345

Michigan.—Continued.

St. Charles....	1,317	Three Rivers....	3,550
St. Clair.....	2,543	Traverse City....	9,407
St. Ignace.....	2,271	Trenton	1,167
St. Johns.....	3,388	Union City.....	1,514
St. Joseph.....	5,155	Vassar	1,832
St. Louis.....	1,989	Wakefield	1,191
Sault Ste.		Wayne	1,361
Marie	10,538	West Bay	
Sebawaing	1,243	City	13,119
Shelby	1,081	West Branch....	1,412
South Haven....	4,009	Whitehall	1,481
Sparta	1,126	Williamston ...	1,113
Stanton	1,234	Wyandotte	5,183
Sturgis	2,465	Yale	1,125
Tawas	1,228	Ypsilanti	7,378
Tecumseh	2,400	Zeeland	1,326

Michoacan', state, Mexico, ☐ 22,874, p. 887,008.

Middlesex, co., Eng., ☐ 233, p. 792,225.

Middlesbrough, town, Eng., p. 91,317.

Milan, city, Italy, p. 492,162.

Milwaukee, Wis., p. 285,315.

Mindana'o, second largest of Philippine Isls., ☐ 57,500.

Mindo'ro, isl., Philippines, ☐ 4,000.

Minneapolis, Minn., p. 202,718.

Minnesota, No. central state, ☐ 83,365, p. 1,-751,394, * St. Paul.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Adrian	1,253	Marshall	2,088
Adrian	1,258	Melrose	1,768
Aitkin	1,119	Milaca	1,204
Albert Lea....	4,500	Minneapolis 202,718	
Alexandria ...	2,681	Mon evideo	2,146
Anoka	3,769	Moorhead	3,730
Appleton	1,184	Morris	1,934
Austin	5,474	New Prague....	1,228
Barnesville ...	1,326	New Ulm.....	5,403
Belle Plaine...1,121		North Branch 1,211	
Bemidji	2,183	Northfield ...	3,210
Benson	1,525	No. St. Paul...1,110	
Biwabik	1,299	Ortonville	1,247
Blue Earth....2,900		Owatonna	5,561
Brainerd	7,524	Park Rapids...1,313	
Breckenridge 1,292		Pelican Rapids 1,033	
Buffalo	1,040	Perham	1,182
Caledonia	1,175	Pipestone	2,536
Canby	1,100	Plainview	1,038
Cannon Falls 1,239		Preston	1,278
Chacka	2,165	Princeton	1,319
Chatfield	1,426	Red Lake	
Cloquet	3,072	Falls	1,885
Crookson	5,379	Red Wing....	7,525
Detroit	2,000	Redwood Falls 1,661	
Duluth	52,969	Renville	1,075
East Grand		Rochester	6,843
Forks	2,077	Rushford	1,062
Ely	3,717	St. Charles....1,304	
Eveleth	2,752	St. Cloud.....8,663	
Fairmont	3,040	St. James....2,607	
Faribault	7,868	St. Louis	
Fergus Falls..6,072		Park	1,325
Frazee	1,000	St. Paul.....163,065	
Glencoe	1,780	St. Peter.....4,302	
Glenwood	1,116	Sandstone	1,189
Grand Rapids 1,428		Sauk Center...2,220	
Granite Falls 1,214		Sauk Rapids...1,391	
Hastings	3,811	Shakopee	2,047
Hibbing	2,481	Sleepy Eye....2,046	
Hutchinson ...	2,495	So. St. Paul...2,322	
Jackson	1,756	So. Stillwater 1,422	
Janesville....	1,254	Springfield ...	1,511
Jordan	1,270	Spring Valley 1,770	
Kasson	1,112	Staples	1,504
Kenyon	1,202	Stillwater	12,318
Lake City....	2,744	Thief River	
Lake Crystal...1,215		Falls	1,819
Lanesboro ...	1,102	Tower	1,366
Lesueur	1,937	Tracy	1,911
Litchfield	2,280	Two Harbors...3,278	
Little Falls...5,774		Virginia	2,962
Long Prairie...1,385		Wabasha	2,528
Luverne	2,223	Wadena	1,520
Madelia	1,272	Warren	1,276
Madison	1,336	Waseca	3,103
Mankato	10,599	Waterville	1,260
Mapleton	1,008	Wells	2,017

Minnesota.—Continued.

West		Windom	1,944
Minneapolis 1,648		Winnebago	
West St. Paul.1,830		City	1,816
Wheaton	1,132	Winona	19,714
White Bear		Worthington ..	2,386
Lake	1,288	Zumbrota	1,119
Willmar	3,409		

Minsk, city, Russia, p. 91,494.

Mirzapur, city, India, p. 79,787.

Mississippi, 'So. central state, ☐ 46,810, p. 1,551,270, * Jackson.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Aberdeen	3,434	Lumberton ...	1,509
Amory	1,211	McComb	4,477
Bay St. Louis.2,822		Macon	2,057
Biloxi	5,467	Magnolia	1,038
Booneville ...	1,050	Meridian	14,050
Brookhaven ...	2,678	Natchez	12,210
Canton	3,404	New Albany...1,033	
Clarksdale ...	1,773	Ocean Springs 1,255	
Columbus	6,484	Okolona	2,177
Corinth	3,661	Oxford	1,825
Crystal Spgs..1,093		Pass Christian 2,028	
Durant	1,766	Pontotoc	1,010
Ellisville	1,899	Port Gibson...2,113	
Fostoria	1,422	Sardis	1,002
Gloster	1,661	Scranton	2,025
Greenville	7,612	Senatobia	1,156
Greenwood ...	3,026	Starkville	1,986
Grenada	2,568	Summit	1,499
Gulfport	1,060	Tupelo	2,118
Hattiesburg ...	4,175	Vicksburg ...	14,834
Hazlehurst ...	1,579	Water Valley...3,813	
Holly Springs.2,815		Wesson	3,279
Jackson	7,816	West Point...3,193	
Kosciusko	2,078	Winona	2,455
Laurel	3,193	Woodville	1,043
Lexington	1,516	Yazoo	4,944

Missouri, No. central state, ☐ 69,475, p. 3,106,-665, * Jefferson City.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Albany	2,025	Fulton	4,883
Appleton City.1,133		Gallatin	1,780
Ash Grove....1,039		Glasgow	1,672
Aurora	6,191	Granby	2,315
Belton	1,005	Grant City....1,406	
Bethany	2,093	Greenfield	1,406
Bevier	1,808	Greenville	1,051
Bloomfield ...	1,475	Hamilton	1,804
Bolivar	1,869	Hannibal	12,780
Boonville	4,377	Harrisonville 1,844	
Bowling Green 1,902		Hermann	1,575
Breckenridge 1,012		Higbee	1,151
Brookfield ...	5,484	Higginsville.. 2,791	
Brunswick ...	1,403	Holden	2,126
Butler	3,158	Humansville.. 1,055	
California ...	2,181	Huntsville ...	1,805
Cameron	2,979	Independence 6,974	
Canton	2,365	Jackson (Cape	
Cape		Girardeau	
Girardeau ..	4,815	Co.)	1,658
Carl Junction.1,177		Jefferson City 9,664	
Carrollton ...	3,854	Joplin	26,023
Carterville ...	4,445	Kahoka	1,818
Carthage	9,416	Kansas City 163,752	
Caruthersville 2,375		Kennett	1,509
Centralia	1,722	Keytesville ...	1,127
Charleston ...	1,893	Kirksville ...	5,966
Chillicothe ...	6,905	Kirkwood	2,825
Clarence	1,184	La Grange....	1,507
Clinton	5,061	Lamar	2,737
Columbia	5,651	La Plata.....	1,345
Deepwater ...	1,201	Lathrop	1,118
De Soto.....	5,611	Lebanon	2,125
Dexter	1,862	Lees Summit..1,453	
Doniphan	1,508	Lexington	4,190
Edina	1,605	Liberty	2,407
Eldorado Spgs 2,137		Louisiana ...	5,731
Excelsior Spgs 1,881		Macon	4,068
Farmington ...	1,778	Malden	1,462
Fayette	2,717	Marceline ...	2,638
Ferguson	1,015	Marionville ...	1,290
Festus	1,256	Marshall	5,086
Fredericktown 1,577		Maryville	4,577

Missouri.—Continued.

Memphis	2,195	St. Charles....	7,982
Mexico	5,099	St. Genevieve..	1,707
Milan	1,757	St. Joseph....	102,979
Moberly	8,012	St. Louis....	575,238
Monett	3,115	Salem	1,481
Monroe City..	1,929	Salisbury	1,847
Montgomery		Sarcozie	1,126
City	2,026	Savannah	1,886
Mound City..	1,681	Sedalia	15,231
Mountain		Seneca	1,043
Grove	1,004	Shelbina	1,733
Mt. Vernon...	1,206	Sikeston	1,077
Neosho	2,725	Slater	2,502
Nevada	7,461	Spruigfield ..	23,267
New Franklin..	1,156	Stanberry ...	2,654
New Madrid..	1,489	Sweet Springs	1,080
Norborue	1,189	Tarkio	1,901
Odessa	1,445	Thayer	1,276
Oregon	1,032	Tipton	1,337
Oronogo ...	2,073	Trenton	5,396
Osceola	1,037	Troy	1,153
Pacific	1,213	Unionville ...	2,050
Palmyra	2,323	Vandalia	1,168
Paris	1,397	Versailles ..	1,240
Pattonsburg ..	1,065	Warrensburg ..	4,724
Perryville ...	1,275	Washington ...	3,015
Pierce City...	2,151	Webb City....	9,201
Plattsburg ...	1,878	Webster	
Pleasant Hill..	2,002	Groves	1,895
Poplar Bluff..	4,321	Wellsville ...	1,160
Princeton ...	1,575	Weston	1,019
Rich Hill....	4,053	West Plains...	2,902
Richmond	3,478	Willow Spgs..	1,078
Rockport	1,080	Windsor	1,502
Rolla	1,600		

Mobile, Ala., p. 38,469.

Modena, city, Italy, p. 68,195.

Molucca Islands, Dutch E. Indies, □ 43,864, p. 399,208.

Monaco, principality on Mediterranean, □ 8, p. 13,304; towns: Monaco, Condamine, Monte Carlo.

Mongolia, depend. Chinese Empire, □ 1,288,000, p. 2,000,000.

Monlucon, city, France, p. 31,595.

Monmouth, co., Eng., □ 535, p. 230,800.

Mons, city, Belgium, p. 25,599.

Montana, Western state, □ 146,080, p. 243,329, * Helena.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Anaconda ...	9,453	Havre	1,033
Billings	3,221	Helena	10,770
Bozeman	3,419	Kalispel	2,526
Butte	30,470	Lewistown ...	1,096
Deerlodge ...	1,324	Livingston ...	2,778
Dillon	1,530	Miles City....	1,938
Fort Benton..	1,024	Missoula	4,366
Great Falls..	14,930	Red Lodge....	2,152
Hamilton	1,257	Walkerville ..	2,621

Montene'gro, ind. principality, Balkan pen., Europe, □ 3,630, p. 228,000, * Cetinje, p. 2,920.

Monterey', city, Mexico, p. 62,266.

Montevideo, * Uruguay, p. 266,000.

Montgomery, Ala., p. 30,346. — co., Wales, □ 797, p. 54,892.

Montpellier, city, France, p. 73,931.

Montreal, * prov. Quebec, Canada, p. 266,826.

Moradabad, city, India, p. 75,176.

Moravia, prov. Austria, □ 8,583, p. 2,435,081.

More'los, state, Mex., □ 2,773, p. 156,786.

Morelia, city Mexico, p. 33,890.

Morocco, empire, N. E. Africa, □ 219,000, p. (est.) 5,000,000, * Fez.

Moscow, city, Russia, p. 988,614.

Mosul, city, Mesopotamia, Asia, p. 61,000.

Motherwell, town, Scotland, p. 20,423.

Mulhauser, city, Alsace-Lorraine, Germany, p. 82,986.

Munchen Gladbach, city, Prussia, p. 53,662.

Munich, * Bavaria, Germany, p. 499,959.

Munster, prov. Ireland (inc. Clare, Cork, Kerry, Limrick, Tipperary and Waterford counties), □ 9,481, p. 1,075,075.

Munster, city, Prussia, p. 57,135.

Murcia, city, Spain, p. 108,408.

Muscat, * Oman, p. 40,000.

Muttra, city, India, p. 59,574.

Mysore (sor'), state, India, □ 27,936, p. 5,538,482. — Its * p. 68,151.

N

Nagasa'ki, city, Japan, p. 107,422.

Nagoy'a, city, Japan, p. 244,145.

Nagpur', city, India, p. 124,599.

Namangan', city, Rus. Turkestan, p. 61,906.

Na'mur, city, Belgium, p. 32,110.

Nancy, city, France, p. 102,500.

Nanking, city, China, on Yangtse R., p. 250,000.

Nantes, city, France, p. 128,300.

Naples, city, Italy, p. 544,057.

Nashville, * Tenn., p. 80,865.

Natal, So. Africa, So. of Transvaal, British colony, inc. prov. of Zululand, □ 35,019, p. 902,365, * Pietermaritzburg, p. 24,595.

Nebraska, No. central state, □ 77,510, p. 1,066,300, * Lincoln.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Albion	1,369	Neligh	1,135
Alliance	2,535	Norfolk	3,883
Ashland	1,477	North Bend...	1,010
Auburn	2,664	North Platte..	3,640
Aurora	1,921	Oakland	1,008
Beatrice	7,875	Omaha	102,555
Blair	2,970	O'Neill	1,107
Broken Bow..	1,375	Ord	1,372
Central City..	1,571	Pawnee	1,969
Chadron	1,665	Plattsmouth ..	4,964
Columbus ...	3,522	Ponca	1,043
Crete	2,199	Red Cloud....	1,554
David City...	1,845	St. Paul.....	1,475
Edgar	1,040	Schuyler	2,157
Fairbury	3,140	Seward	1,970
Fairfield	1,203	Sidney	1,001
Falls City....	3,022	South Omaha	26,001
Fremont	7,241	Stanton	1,652
Friend	1,200	Stromsburg ...	1,154
Fullerton ...	1,464	Superior	1,577
Geneva	1,534	Sutton	1,365
Graud Island..	7,554	Tecumseh	2,005
Hastings	7,188	Tekamah	1,597
Havelock	1,480	University	
Hebron	1,511	Place	1,130
Holdrege	3,007	Wahoo	2,100
Humboldt ...	1,218	Wayne	2,119
Kearney	5,634	Weeping	
Lexington ...	1,343	Water	1,156
Lincoln	40,169	West Point....	1,890
McCook	2,445	Wilber	1,034
Madison	1,47	Wymore	2,626
Minden	1,238	York	5,132
Nebraska City	7,380		

Negapatam, city, India, p. 56,455.

Negros, isl., Philippines, □ 3,300.

Nepal, kingdom in the Himalayas, Asia, □ 54,000, p. (est.) 5,000,000, * Katmandu, p. 50,000.

Netherlands, The (Holland), kingdom, W. Europe, □ 12,648, p. 5,103,924, * The Hague.

Neully, city, France, p. 32,730.

Nevada, Western state, □ 110,700, p. 42,335, * Carson City.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Carson City...	2,100
Reno	4,500
Virginia City..	2,695

Newark, N. J., p. 246,070.

New Bedford, Mass., p. 62,442.

New Britain, Conn., p. 25,998.

New Brunswick, prov. Canada, □ 28,200, p. 331,093, * Fredericton.

New Caledonia, isl., So. Pacific, Fr. penal colony, □ 6,000, p. 52,756, * Noumea.

Newcastle, Pa., p. 28,339.

Newcastle-upon-Tyne, city, Eng., 214,803.

Newfoundland, isl. G. of St. Lawrence, British, □ 42,200, p. 216,615, * St. John's, p. 29,007.

New Guinea, isl. E. Indies, belongs to Gr. Britain, Holland and Germany, □ 300,000, p. 813,000.

New Hampshire, No. Atlantic state, □ 9,305, p. 411,588, * Concord.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Berlin	8,886	Manchester	56,987
Coneord	19,632	Nashua	23,898
Dover	13,207	Portsmouth	10,637
Franklin	5,846	Rochester	8,466
Keene	9,165	Somersworth	7,023
Laconia	8,042		

New Haven, Conn., p. 108,027.

New Jersey, No. Atlantic state, □ 7,185, p. 1,883,669, * Trenton.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Asbury Park	4,148	Lodi	1,917
Atlantic City	27,838	Long Branch	8,872
Atlantic Highlands	1,383	Madison	3,754
Bayonne	32,722	Manasquan	1,500
Belvidere	1,784	Matawan	1,511
Beverly	1,950	Merehanville	1,608
Bloomfield	9,668	Metuchen	1,786
Boonton	3,901	Midland Park	1,348
Bordentown	4,110	Millville	10,583
Boundbrook	2,622	Montclair	13,962
Bridgeton	13,913	Morristown	11,267
Burlington	7,392	Neptune City	1,009
Caldwell	1,367	Newark	246,070
Camden	75,935	New Brunswick	20,006
Cape May	2,257	Newton	4,376
Carlstadt	2,574	No. Plainfield	5,009
Chatham	1,361	Ocean City	1,307
Clayton	1,951	Orange	24,141
Collingswood	1,633	Passaic	27,777
Deckertown	1,306	Paterson	105,171
Dover	5,938	Penngrove	1,826
Dunellen	1,239	Perth Amboy	17,699
East Newark	2,500	Phillipsburg	10,052
East Orange	21,506	Plainfield	15,369
E. Rutherford	2,640	Pleasantville	2,182
Egg Harbor	1,808	Port Oram	2,060
Elizabeth	52,130	Princeton	3,899
Elmer	1,140	Rahway	7,935
Englewood	6,253	Raritan	3,244
Fairview	1,003	Red Bank	5,428
Flemington	2,145	Ridgewood	2,685
Freehold	2,934	Riverton	1,332
Frenchtown	1,020	Rockaway	1,483
Garfield	3,504	Roselle	1,652
Glen Ridge	1,960	Rutherford	4,411
Gloucester City	6,840	Salem	5,811
Guttenberg	3,825	Seabright	1,198
Haekensaek	9,443	Secaucus	1,626
Hackettstown	2,474	Somerville	4,843
Haddonfield	2,776	South Amboy	6,349
Hammononton	3,481	South Orange	4,608
Harrison	10,596	South River	2,792
Hasbrouck Heights	1,255	Summit	5,302
Hawthorne	2,096	Tenafly	1,746
High Bridge	1,377	Trenton	73,307
Highlands	1,228	Undercliff	1,006
Hightstown	1,749	Union	15,187
Hoboken	59,364	Vailsburg	2,779
Irvington	5,255	Vineland	4,370
Jamesburg	1,063	Wellington	1,812
Jersey City	206,433	Washington	3,580
Kearney	10,896	W. Hoboken	23,094
Keyport	3,413	W. New York	5,267
Lambertville	4,637	West Orange	6,889
Little Ferry	1,240	Woodbury	4,087
		Woodstown	1,371

New Mexico, ter. S. W. part U. S., □ 122,580, p. 195,310, * Santa Fe.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Alamogordo	1,050	Lincoln	1,000
Albuquerque	6,238	Mora	1,250
Carlsbad	1,063	Raton	3,540
Deming	1,136	Roswell	2,049
Gallup	2,946	Santa Fe	5,603
Gardiner	1,120	Silver City	2,735
Las Cruces	1,200	Socorro	1,512
Las Vegas	3,552	Taos	1,225

New Orleans, La., p. 287,104.

Newport, Ky., p. 28,301. — (Monmouth), town, Eng., p. 67,290.

New South Wales, state, Australia, □ 310,367, p. 1,362,232, * Sydney.

Newton, Mass., p. 33,587.

New York, No. Atlantic state, □ 49,170, p. 7,268,894, * Albany.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Adams	1,292	Fairport	2,489
Addison	2,080	Falconer	1,136
Akron	1,585	Fayetteville	1,304
Albany	94,151	Fishkill Landing	3,673
Albion	4,477	Fonda	1,145
Alexandria Bay	1,511	Fort Edward	3,521
Amityville	2,038	Fort Plain	2,444
Amsterdam	20,929	Frankfort	2,664
Athens	2,171	Franklinville	1,360
Attica	1,785	Fredonia	4,127
Auburn	30,345	Freeport	2,612
Avoca	1,006	Friendship	1,214
Avon	1,601	Fulton	5,281
Babylon	2,157	Geneseo	2,400
Bainbridge	1,092	Geneva	10,433
Baldwinsville	2,992	Glens Falls	12,613
Ballston Spa	3,923	Gloversville	18,349
Batavia	9,180	Goshen	2,826
Bath	4,994	Gouverneur	3,689
Bath-on-Hudson	2,504	Gowanda	2,143
Belmont	1,190	Granville	2,700
Binghamton	39,647	Greene	1,236
Bolivar	1,208	Green Island	4,770
Bonnaville	1,745	Greenport	2,366
Brewster	1,192	Greenwich	1,869
Brockport	3,398	Groton	1,344
Buffalo	352,387	Hamburg	1,683
Caledonia	1,073	Hamilton	1,627
Cambridge	1,578	Hammondsport	1,169
Camden	2,370	Hancock	1,283
Canajoharie	2,101	Hastings-on-Hudson	2,002
Canandaigua	6,151	Haverstraw	5,935
Canastota	3,030	Hempstead	3,582
Canisteo	2,077	Herkimer	5,555
Canton	2,757	Holley	1,380
Cape Vincent	1,310	Homer	2,381
Carthage	2,895	Honeoye Falls	1,175
Castile	1,088	Hoosiek Falls	5,671
Castleton	1,214	Hornellsville	11,918
Catskill	5,484	Horseheads	1,901
Cattaraugus	1,382	Hudson	9,528
Cazenovia	1,819	Ilion	5,138
Champlain	1,311	Irvington	2,231
Charlotte	1,400	Ithaca	13,136
Chatham	2,018	Jamestown	22,892
Chester	1,250	Johnstown	10,130
Clayton	1,913	Jordan	1,118
Clifton Spgs.	1,617	Keeseville	2,110
Clinton	1,340	Kirgston	24,535
Clyde	2,507	Laneaster	3,750
Cobleskill	2,327	Lansingburg	12,595
Cohoes	23,910	Leroy	3,144
Cold Spring	2,067	Lestershire	3,111
Cooperstown	2,368	Liberty	1,760
Corinth	2,039	Little Falls	10,381
Corning	11,061	Little Valley	1,085
Cornwall	1,966	Liverpool	1,133
Cortland	9,014	Lockport	16,581
Coxsackie	2,735	Lowville	2,352
Croton-on-Hudson	1,533	Lyons	4,300
Cuba	1,502	Malone	5,935
Dansville	3,633	Manlius	1,219
Delhi	2,078	Marathon	1,092
Depew	3,379	Massena	2,032
Deposit	2,051	Matteawan	5,807
Dobbs Ferry	2,888	Mechanicsville	4,695
Dolgeville	1,915	Medina	4,716
Dundee	1,291	Mexico	1,249
Dunkirk	11,616	Middleburg	1,135
East Aurora	2,366	Middleport	1,431
East Syracuse	2,509	Middletown	14,522
Ellenville	2,879	Millbrook	1,027
Elmira	35,672	Mohawk	2,028
Elmira Heights	1,763	Monticello	1,160
		Montour Falls	1,193

New York.—Continued.

Moravia1,442
 Mt. Kisco.....1,346
 Mt. Morris....2,410
 Mt. Vernon...21,228
 Naples1,048
 Newark4,578
 New Berlin...1,156
 Newburg24,943
 NewHartford 1,007
 Newpaltz1,022
 New
 Rochelle ..14,720
 New York
 City3,437,202
 Manhattan bor-
 ough ..1,850,093
 Bronx
 borough 200,507
 Brooklyn bor-
 ough ..1,166,582
 Richmond
 borough 67,021
 Queens
 borough 152,999
 Niagara
 Falls19,457
 North Olean..1,549
 Northport ...1,794
 North Tarry-
 town4,241
 North Tona-
 wanda9,069
 Northville ...1,046
 Norwich5,766
 Norwood1,714
 Nunda1,018
 Nyack4,275
 Ogdensburg. 12,633
 Olean9,462
 Oneida6,364
 Oneonta7,147
 Ossining7,939
 Oswego22,199
 Oswego Falls.2,925
 Owego5,039
 Oxford1,931
 Palmyra1,937
 Patchogue ...2,926
 Peekskill ...10,358
 Penn Yan....4,650
 Perry2,763
 Phelps1,306
 Philmont1,964
 Phoenix1,532
 Piermont1,153
 Pittsford1,000
 Plattsburg ...8,434
 Pleasantv'le. 1,204
 Port Byron...1,013
 Port Chester.7,440
 Port Henry...1,751
 Port Jervis...9,385
 Potsdam3,843
 Pough-
 keepsie ...24,029
 Pulaski1,493
 Randolph1,209
 Rensselaer ...7,466
 Rhinebeck ...1,494
 Richfield
 Springs ...1,537

New Zealand, group of isls., S. E. of Aus-
 tralia, British, □ 104,471, p. 796,359, *
 Wellington, p. 37,441.

Nganhwei, prov. China, □ 53,000, p. 20,-
 596,000.

Nicaragua, republic of Cen. Am., □ 49,200,
 p. 380,000, * Managua, p. 25,000.

Nice, city, France, p. 125,100.

Nigeria, region on Gulf of Guinea, W. Africa,
 British. Est. area, □ 500,000, p. est. 25 to
 40 millions. Divided into Northern and
 Southern Nigeria.

Niigata, city, Japan, p. 53,366.

Nikolaiev, city, Russia, p. 92,060.

Nîmes, city, France, p. 74,601.

Niuchwang, city, Manchuria, p. 60,000.

Nizhni-Novgorod, city, Russia, p. 95,124.

Rochester ..162,608
 Rockton1,052
 Rockville
 Center1,884
 Rome15,343
 Rosendale ...1,840
 Rouse Point..1,675
 Sacketts
 Harbor1,266
 Sag Harbor...1,969
 St. Johnsville 1,873
 Salamanca ...4,251
 Salem1,391
 Sandy Hill...4,473
 Saranac Lake 2,504
 Saratoga
 Springs ...12,409
 Saugerties ...3,697
 Schaghticoke 1,061
 Schenectady 31,682
 Schoharie ...1,006
 Schuylerville 1,601
 Sea Cliff.....1,558
 Seneca Falls..6,519
 Sidney2,331
 Silver Creek..1,944
 Skaneateles ..1,495
 Solvay3,493
 Southampton 2,289
 South Glens
 Falls2,025
 South Nyack..1,601
 Springville ...1,992
 Stillwater ...1,007
 Suffern1,619
 Syracuse108,374
 Tarrytown ...4,770
 Ticonderoga .1,911
 Tivoli1,153
 Tonawanda ...7,421
 Troy60,651
 Trumansburg 1,225
 Unadilla1,172
 Utica56,383
 Valatie1,300
 Walden3,147
 Walton2,811
 Wappingers
 Falls3,504
 Warsaw3,048
 Warwick1,735
 Waterford ...3,146
 Waterloo4,256
 Watertown ...21,696
 Waterville ...1,571
 Watervliet .14,321
 Watkins2,943
 Waverly4,465
 Wayland1,307
 Weedsport ...1,525
 Wellsville ...3,556
 W. Carthage..1,135
 Westfield ...2,430
 West
 Haverstraw 2,079
 Whitehall4,377
 White Plains.7,899
 Whiteboro ...1,958
 Wolcott1,279
 Yonkers47,931

Norfolk, Va., p. 46,624. — Co. Eng., □ 2,037,
 p. 313,438.

Norrköping, city, Sweden, p. 40,472.

North America, see America.

Northampton, co. Eng., □ 914, p. 207,467. —
 Its * p. 87,021.

North Carolina, So. Atlantic state, □ 52,250,
 p. 1,893,810, * Raleigh.

Incorporated cities and towns of 1,000 pop.
 or more in 1900:

Albemarle ....1,382	Marion .....1,116
Asheville ....14,694	Monroe .....2,427
Beaufort .....2,195	Mooresville ..1,533
Bessemer City 1,100	Morehead
Burlington ...3,692	City .....1,379
Caroleen .....1,706	Morganton ...1,938
Chapel Hill...1,099	Mt. Airy.....2,680
Charlotte ....18,091	Newbern .....9,090
Cherryville ...1,008	Newton .....1,583
Concord .....7,910	Oxford .....2,059
Dunn .....1,072	Plymouth ....1,011
Durham .....6,679	Raleigh .....13,643
Edenton .....3,046	Randleman ...2,190
Elizabeth City.6,348	Reidsville ...3,262
Fayetteville ..4,670	Roanoke
Forest City...1,090	Rapids .....1,009
Gastonia .....4,610	Rockingham ..1,507
Goldsboro ....5,877	Rocky Mount.2,937
Graham .....2,052	Roxboro .....1,021
Greensboro ...10,035	Salem .....3,642
Greenville ...2,565	Salisbury ....6,277
Henderson ...3,746	Sanford .....1,044
Henderson- ville .....1,917	Scotland
Henrietta ....1,250	Neck .....1,348
Hertford .....1,382	Shelby .....1,874
Hickory .....2,535	Southport ...1,336
High Point...4,163	Statesville ...3,141
Kings Moun- tain .....2,062	Tarboro .....2,499
Kinston .....4,106	Wadesboro ...1,546
Laurinburg ...1,334	Washington ..4,842
Lenoir .....1,296	Waynesville ..1,307
Lexington ....1,234	Weldon .....1,423
Louisburg ....1,178	Wilmington .20,976
McAdenville ..1,144	Wilson .....3,525
	Winston .....10,008

North Dakota, No. Central state, □ 70,795,
 p. 319,146, * Bismarck.

Incorporated cities and towns of 1,000 pop.
 or more in 1900:

Bismarck .....3,319	Langdon .....1,188
Cando .....1,061	Larimore .....1,235
Casseltown ...1,207	Lisbon .....1,046
Devils Lake...1,729	Mandan .....1,658
Dickinson ....2,076	Mayville .....1,166
Fargo .....9,589	Minot .....1,277
Grafton .....2,378	Park River...1,088
Grand Forks..7,652	Valley City...2,446
Hillsboro ....1,172	Wahpeton ...2,228
Jamestown ...2,853	

Northumberland, co. Eng., □ 2,007, p.
 388,059.

North-West Provinces, states, Brit. India,
 □ 5,109, p. 799,675.

Norway, kingdom, N. Europe, □ 124,445, p.
 2,231,395, * Christiania.

Norwich, city, Eng., p. 11,728.

Nossi-Be Island, w. coast of Madagascar, of
 which it is a dependency, □ 130, p. 9,500.

Nottingham, co. Eng., □ 826, p. 274,684. —
 Its * p. 239,753.

Novara, city, Italy, p. 47,300.

Nova Scotia, prov. Canada, □ 20,600, p.
 459,116, * Halifax.

Novotcherkask, city, Russia, p. 52,005.

Nuevo Leon, state, Mex., □ 23,592, p. 307,856.

Nuremberg, city, Bavaria, Germany, p.
 261,022.



Oakland, Cal., p. 66,960.

Oaxaca, state, Mex., □ 35,382, p. 872,802. —
 Its * p. 32,437.

Odense, city, Denmark, p. 30,277.

Odessa, city, Russia, p. 405,041.

Offenbach, city, Hesse, Germany, p. 39,408.

Ohio, No. Central state, ☐ 41,060, p. 4,157,-545, * Columbus.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ada	2,576	Evanston	1,716
Addyston	1,513	Fairport	2,073
Akron	42,728	Findlay	17,613
Alliance	8,974	Forest	1,155
Antwerp	1,206	Ft. Recovery	1,097
Arcanum	1,225	Fostoria	7,730
Ashland	4,087	Franklin	2,724
Ashtabula	12,949	Fremont	8,439
Athens	3,066	Galion	7,282
Barberton	4,354	Gallipolis	5,432
Barnesville	3,721	Garettsville	1,145
Batavia	1,029	Geneva	2,342
Bedford	1,486	Georgetown	1,529
Bellaire	9,912	Germantown	1,702
Bellefontaine	6,649	Gibsonburg	1,791
Bellevue	4,101	Girard	2,630
Bellville	1,039	Glendale	1,545
Berea	2,510	Glennville	5,588
Blanchester	1,788	Glouster	2,155
Bluffton	1,783	Grafton	1,098
Bond Hill	1,081	Granville	1,425
Bowling		Greenfield	3,979
Green	5,067	Greenville	5,501
Bradford	1,254	Hamilton	23,914
Bradner	1,148	Harrison	1,456
Bridgeport	3,963	Hartwell	1,833
Bryan	3,131	Hicksville	2,520
Bucyrus	6,560	Hillsboro	4,535
Byesville	1,267	Holgate	1,237
Cadiz	1,755	Hubbard	1,230
Cambridge	8,241	Huron	1,708
Canal Dover	5,422	Hyde Park	1,691
Canal Fulton	1,172	Irondale	1,136
Canton	30,667	Ironton	11,868
Cardington	1,354	Jackson	4,672
Carey	1,816	Jacksonville	1,047
Carrollton	1,271	Jamestown	1,205
Carthage	2,559	Jefferson	1,319
Cedarville	1,189	Kelleys	
Celina	2,815	Island	1,174
Chagrin Falls	1,586	Kent	4,541
Chardon	1,360	Kenton	6,852
Chicago Jct.	2,348	Lakewood	3,355
Chillicothe	12,976	Lancaster	8,991
Cincinnati	325,902	Lebanon	2,867
Circleville	6,991	Leetonia	2,744
Cleveland	381,768	Leipsic	1,726
Cleves	1,328	Lima	21,723
Clyde	2,515	Lisbon	3,330
Coalgrove	1,191	Lockland	2,695
Coalton	1,625	Logan	3,480
College Hill	1,104	London	3,511
Collinwood	3,639	Lorain	16,028
Columbiana	1,339	Loudonville	1,581
Columbus	125,560	Louisville	1,374
Columbus		Loveland	1,260
Grove	1,935	Lowellville	1,137
Conneaut	7,133	McComb	1,195
Continental	1,104	McConnels-	
Corning	1,401	ville	1,825
Coshocton	6,473	Madisonville	3,140
Covington	1,791	Manchester	2,003
Crestline	3,282	Mansfield	17,640
Cuyahoga		Marletta	13,348
Falls	3,186	Marion	11,862
Dayton	85,333	Martins	
Defiance	7,579	Ferry	7,760
DeGraff	1,150	Marysville	3,048
Delaware	7,940	Massillon	11,944
Delphos	4,517	Maumee	1,856
Delta	1,230	Mechanicsv'le	1,617
Dennison	3,763	Medina	2,232
Deshler	1,628	Miamisburg	3,941
Doylestown	1,057	Middleport	2,799
Dresden	1,600	Middletown	9,215
Dunkirk	1,222	Milford	1,149
E. Cleveland	2,757	Millersburg	1,998
E. Liverpool	16,485	Mineral City	1,220
E. Palestine	2,493	Minerva	1,200
Eaton	3,155	Mingo Jct.	2,954
Edgerton	1,043	Minster	1,465
Elmore	1,025	Monroeville	1,211
Elmwood		Montpelier	1,869
Place	2,532	Mt. Gilead	1,528
Elyria	8,791	Mt. Healthy	1,354

Ohio.—Continued.

Mt. Vernon	6,633	Salineville	2,353
Murray City	1,118	Sandusky	19,664
Napoleon	3,639	Scio	1,214
Nelsonville	5,421	Shawnee	2,966
Newark	18,157	Shelby	4,685
New Bremen	1,318	Shreve	1,043
Newburg	5,909	Sidney	5,688
New Comers-		Somersct	1,124
town	2,659	S. Brooklyn	2,343
New Lexington		S. Charleston	1,096
(Perry Co.)	1,701	Spencerville	1,874
New London	1,180	Springfield	38,253
New Philadel-		Steubenville	14,349
phia	6,213	Stryker	1,206
N. Richmond	1,916	Tiffin	10,989
N. Straitsv'le	2,302	Tippecanoe	1,703
Niles	7,468	Toledo	131,822
North Am-		Toronto	3,526
herst	1,758	Troy	5,881
North Balti-		Uhrichsville	4,582
more	3,561	Union City	1,282
Norwalk	7,074	Upper San-	
Norwood	6,480	dusky	3,355
Oak Harbor	1,631	Urbana	6,808
Oberlin	4,082	Van Wert	6,422
Orrville	1,901	Vermilion	1,184
Ottawa	2,322	Versailles	1,478
Oxford	2,009	Wadsworth	1,764
Painesville	5,024	Wapakoneta	3,915
Paulding	2,080	Warren	8,529
Payne	1,336	Washington Court	
Pemberville	1,081	House	5,751
Perrysburg	1,766	Washington-	
Piqua	12,172	ville	1,092
Plain City	1,432	Wauseon	2,148
Pleasant City	1,006	Waverly	1,854
Plymouth	1,154	Wellington	2,094
Pomeroy	4,639	Wellston	8,045
Port Clinton	2,450	Wellsville	6,146
Portsmouth	17,870	Westerville	1,462
Ravenna	4,003	West Liberty	1,236
Reading	3,076	West Union	1,033
Richwood	1,640	Williamsburg	1,002
Ripley	2,248	Willoughby	1,753
Rockford	1,207	Wilmington	3,613
Rockport	2,038	Winton Place	1,219
Rocky River	1,319	Woodsfield	1,801
Roseville	1,207	Wooster	6,063
Sabina	1,481	Wyoming	1,450
St. Bernard	3,384	Xenia	8,696
St. Clairsv'le	1,210	Yellow Spgs.	1,371
St. Marys	5,359	Youngstown	44,885
St. Paris	1,222	Zanesville	23,538
Salem	7,582		

Okayama, city, Japan, p. 58,025.

Oklahoma, ter. So. Central pt. U. S., ☐ 39,030, p. 398,331, * Guthrie.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Aiwa	1,499	Norman	2,225
Blackwell	2,283	Oklahoma	
Chandler	1,430	City	10,037
Elreno	3,383	Pawnee	1,464
Enid	3,444	Perry	3,351
Guthrie	10,006	Ponca	2,528
Hennessey	1,367	Shawnee	3,462
Kingfisher	2,301	Stillwater	2,431
Newkirk	1,754	Tecumseh	1,193
		Weatherford	1,017

Oldenburg, Ger. grand-duchy, ☐ 2,479, p. 398,499, * Oldenburg, p. 25,472.

Oldham, city, Eng., p. 137,238.

Old Marghelan, city, Rus. Turkestan, p. 36,592.

Omaha, Neb., p. 102,555.

Oman, ind. state, S. E. Arabia, ☐ 82,000, p. 1,500,000, * Muscat.

Omsk, city, Siberia, p. 37,470.

Ontario, prov., Canada, ☐ 222,000, p. 2,167,-978, * Toronto.

Oporto, city, Portugal, p. 138,860.

Oran, city, Algeria, p. 85,081.

Orange Free State, see Orange River Colony.
Orange River Colony, British, So. Afrlca, ☐ 48,326, p. 207,503, * Bloemfontein.

Oregon, Western state, □ 96,030, p. 413,536,
* Salem.

Incorporated cities and towns of 1,000 pop.
or more in 1900:

Albany	3,149	LaGrande	2,991
Ashland	2,634	McMinnville	1,420
Astoria	8,381	Marshfield	1,391
Baker City.....	6,663	Medford	1,791
Corvallis	1,819	Oregon City.....	3,494
Dallas	1,271	Pendleton	4,406
Eugene	3,236	Portland	90,426
Forest Grove.....	1,096	Roseburg	1,630
Grants Pass.....	2,290	Salem	4,258
Heppner	1,146	The Dalles.....	3,542

Orel, city, Russia, p. 69,858.

Orenburg, city, Russia, p. 72,740.

Orizaba, city, Mexico, p. 31,512.

Orleans, city, France, p. 66,619.

Osaka, city, Japan, p. 821,235.

Osh, city, Rus. Turkestan, p. 36,474.

Oshkosh, Wis., p. 28,284.

Ostend, city, Belgium, p. 38,481.

Otaru, city, Japan, p. 56,961.

Ottawa, * Canada, p. 59,902.

Ottoman Empire, see Turkey.

Oudh, prov., Brit. India, □ 24,217, p.
12,884,750.

Ouro Preto, city, Brazil, p. 59,249.

Oviedo, city, Spain, p. 46,376.

Oxford, co., Eng., □ 750, p. 137,118. — Its
* p. 49,413.

P

Pachuca, city, Mexico, p. 37,487.

Padua, city, Italy, p. 83,748.

Paisley, city, Scotland, p. 79,355.

Palermo, city, Italy, p. 292,799.

Palma, city, Balearic Islands, Spain, p. 62,525.

Panama, city, Colombia, p. 30,000.

Panay, isl., Philippines, □ 4,700.

Paraguay, republic, So. Am., □ 98,000, p.
600,000, * Asuncion.

Paramaribo, * Dutch Guiana, p. 31,200.

Paris, * France, on Seine R., p. 2,685,438.

Parma, city, Italy, p. 55,205.

Partick, city, Scotland, p. 54,274.

Passaic, N. J., p. 27,777.

Paterson, N. J., p. 105,171.

Patna, city, India, p. 135,172.

Patras, city, Greece, p. 37,958.

Pau, city, France, p. 33,012.

Pavia, city, Italy, p. 38,722.

Pawtucket, R. I., p. 39,231.

Peking, * Chinese Empire, p. (est.) 1,300,000.

Pelew (Palao) Islands, group in N. Pacific,
belong to Germany.

Pelotas, city, Brazil, p. 41,591.

Pembroke, co., Wales, □ 614, p. 87,910. —
City, Ireland, p. 25,524.

Pennsylvania, No. Atlantic state, □ 45,215,
p. 6,302,115, * Harrisburg.

Incorporated cities and towns of 1,000 pop.
or more in 1900:

Allegheny	129,806	Berlin	1,030
Allentown	35,416	Berwick (Co-	
Altoona	38,973	lumbia Co.)	3,916
Ambler	1,884	Bethlehem	7,293
Apollo	2,924	Blrdsboro	2,264
Archbald	5,396	Blairsville	3,386
Arnold	1,426	Blakely	3,915
Ashland	6,438	Bloomsburg	6,170
Ashley	4,046	Blossburg	2,423
Aspinwall	1,231	Boyertown.....	1,709
Athens	3,749	Braddock	15,654
Austin	2,300	Bradford.....	15,029
Avalon	2,130	Bridgeport (Fay-	
Avoca	3,487	ette Co.)	1,805
Bangor	4,106	Bridgeport (Mont-	
Barnesboro	1,482	gomery Co.)	3,097
Beaver	2,348	Bridgewater	1,347
Beaver Falls.....	10,054	Bristol.....	7,104
B'ver M'dows.....	1,378	Brockwayville.....	1,777
Bedford	2,167	Brookville.....	2,472
Bellefonte	4,216	Brownsville.....	1,532
Bellevernon	1,901	Butler.....	10,853
Bellevue	3,416	California.....	2,009
Bellwood	1,545	Cambridge Sp'sl.....	495

Pennsylvania.—Continued.

Canonsburg	2,714	Glen Campbell.....	1,628
Canton	1,525	Glen Rock.....	1,117
Carbondale	13,536	Gordon	1,165
Carlisle	9,626	Greencastle	1,463
Carnegie	7,320	Greensburg	6,508
Catasauqua	3,963	Greenville	4,814
Catawissa	2,023	Grove City.....	1,599
Centralia	2,048	Hallstead	1,404
Chambersburg	8,864	Hamburg	2,315
Charleroi	5,930	Hanover	5,302
Chester	33,988	Harrisburg	50,167
Clarendon	1,092	Hastings	1,621
Clarion	2,004	Hawley	1,925
Clayville (Jeffer-		Hazleton	14,230
son Co.)	2,371	Holidaysburg	2,998
Clearfield	5,081	Homestead	12,554
Clifton Heights.....	2,330	Honesdale	2,864
Coatesville	5,721	Houtzdale	1,482
Columbia	12,316	Hughestown	1,548
Colwyn	1,226	Hughesville	1,528
Connellsville	7,160	Hummelstown	1,729
Conshohocken	5,762	Huntingdon	6,053
Coplay	1,581	Hyndman	1,242
Corapolis	2,555	Indiana	4,142
Corry	5,369	Irwin	2,452
Coudersport	3,217	Jeannette	5,865
Crafton	1,927	Jeddo	1,632
Cressona	1,738	Jenkintown	2,091
Curwensville	1,937	Jermyn	2,567
Dale	1,503	Jersey Shore.....	3,070
Dallastown	1,181	Johnsonburg	3,894
Danville	8,042	Johnstown	35,936
Darby	3,429	Juniata	1,709
Derry	2,347	Kane	5,296
Dickson	4,948	Kennett Square.....	1,516
Dorrance	2,211	Kingson	3,346
Downingtown	2,133	Kittanning	3,902
Doylestown	3,034	Knoxville (Alle-	
Dubar	1,662	gheny Co.)	3,511
Dubois	9,375	Kutztown	1,328
Duncannon	1,661	Lancaster	41,459
Duncansville	1,512	Lansdale	2,754
Dunmore	12,583	Lansdowne	2,630
Duquesne	9,036	Lansford	4,888
East Brady.....	1,233	Latrobe	4,614
E. Conemaugh.....	2,175	Lebanon	17,628
E. Greensburg.....	1,050	Leechburg	2,459
East Mauch		Leighton	4,629
Chunk	3,458	Lewisburg	3,457
Easton	25,238	Lewistown	4,451
East Pittsburg	2,883	Ligonier	1,259
E. Stroudsburg	2,648	Lilly	1,276
E. Washington.....	1,051	Lititz	1,637
Ebensburg	1,574	Littlestown	1,118
Edgewood	1,139	Lock Haven	7,210
Edwardsville	5,165	Luzerne	3,817
Elizabeth	1,866	Lykens	2,762
Elizabethtown	1,473	McAdoo	2,122
Elkland	1,109	McDonald	2,475
Elliott	3,345	McKeesport	34,227
Ellwood City.....	2,243	McKees Rock	6,352
Emaus	1,468	McSherrystown	1,490
Emlenton	1,190	Mahanoy City	13,504
Emporium	2,463	Manheim	2,019
Ephrata	2,451	Mansfield	1,847
Erie	52,733	Marcus Hook	1,209
Esplen	2,364	Marietta	2,469
Etna	5,384	Marysville	1,463
Evans City.....	1,203	Mauch Chunk.....	4,029
Everett	1,864	Mayfield	2,300
Exeter	1,948	Meadville	10,291
Fairchance	1,219	Mechanicsburg	
Fayette City.....	1,595	(Cumbr'd Co.)	3,841
Ford City.....	2,870	Media	3,075
Forest City.....	4,279	Mercer	1,804
Forty Fort.....	1,557	Meyersdale	3,024
Fountain Hill.....	1,214	Middletown	5,608
Frackville	2,594	Mifflinburg	1,436
Franklin (Vc-		Millersburg	1,675
nango Co.)	7,317	Mill Hall.....	1,010
Freedom	1,733	Millvale	6,736
Freeland	5,254	Milton	6,175
Freeport	1,754	Miners Mills.....	2,224
Galeton	2,415	Minersville	4,815
Gallitzin	2,759	Monaca	2,008
Gettysburg	3,495	Monessen	2,197
Gilberton	4,373	Monongahela	5,173
Glarville	3,666	Montgomery	1,063

Pennsylvania.—Continued.

Montoursville ..1,665	St. Clair.....4,638
Montrose .....1,827	St. Marys.....4,295
Moosic .....1,227	Sayre.....5,243
Morrisville .....1,371	Schuylkill
Mt. Carmel.....13,179	Haven .....3,651
Mt. Holy Sp's..1,328	Scottdale.....4,261
Mt. Jewett.....1,553	Seranton... ..102,026
Mt. Joy.....2,018	Selinsgrove... ..1,326
Mt. Oliver.....2,295	Sellersville.....1,247
Mt. Pleasant...4,745	Sewickley .....3,568
Mt. Union.....1,985	Shamokin .....18,202
Muncy .....1,934	Sharon .....8,916
Nanticoke .....12,116	Sharon Hill....1,058
Nazareth .....2,304	Sharpsburg .....6,842
Nescopeck .....1,100	Sharpsville .....2,970
New Bethlehem..1,269	Shenandoah .....20,321
New Brighton..6,820	Sheraden .....2,948
Newcastle .....28,339	Shickshinny ...1,456
New Cumber-	Shippensburg ..3,228
land .....1,035	Slatington .....3,773
New Haven.....1,532	Smethport .....1,704
New Hope.....1,218	Somerset .....1,834
New Kensing-	Souderton .....1,077
ton .....4,665	South Bethle-
New Philadel-	hem (North-
phia .....1,326	ampton Co.)..13,241
Newport .....1,734	South Fork.....2,635
Newtown .....1,463	South Washing-
Newville .....1,655	ton .....1,230
Norristown ....22,265	South Waverly 1,215
North Braddock.6,535	South Williams-
Northeast .....2,068	port .....3,328
Northumber-	Spangler .....1,616
land .....2,748	Spring City.....2,566
North Wales...1,287	Spring Garden 1,015
North Washing-	Steelton .....12,086
ton .....1,473	Spring Grove...1,005
North York....1,185	Stoneboro .....1,061
Norwood .....1,286	Stroudsburg ...3,450
Oakdale .....1,147	Sugar Notch...1,887
Oakland .....1,003	Summit Hill...2,986
Oakmont .....2,323	Sunbury .....9,810
Oil City.....13,264	Susquehanna ...3,813
Old Forge.....5,630	Swissvale .....1,716
Olyphant .....6,180	Swoyersville ...2,264
Orwigsburg ....1,518	Tamaqua .....7,297
Osceola (Clear-	Tarentum .....5,472
field Co.)....2,030	Taylor .....4,215
Oxford .....2,032	Throop .....2,204
Palo Alto.....1,707	Tidloute .....1,237
Parker's Land-	Titusville .....8,244
ing .....1,070	Towanda .....4,663
Parkersburg ...1,788	Tower City.....2,167
Parnassus .....1,791	Tremont.....1,947
Parsons .....2,529	Troy .....1,450
Patton .....2,651	Tunkhannock ..1,305
Pen Argyl.....2,784	Turtle Creek...3,262
Pennsburg ....1,032	Tyrone.....5,847
Perkasie .....1,803	Union City.....3,104
Philadelphia 1,293,697	Uniontown (Fay-
Philipsburg ...3,266	ette Co.) .....7,344
Phoenixville ...9,196	Upland. ....2,131
Pinegrove .....1,084	Vandergrift... ..2,076
Pitcairn .....2,601	Vandergrift
Pittsburg ....321,616	Heights.....1,910
Pittston .....12,556	Verona.....1,904
Plymouth .....13,649	Warren.....8,043
Polk .....1,037	Washington (Wash-
Port Allegany...1,853	ington Co.)...7,670
Port Carbon...2,168	Watsonstown ...1,898
Port Vue.....1,803	Waynesboro ...5,396
Pottstown .....13,696	Waynesburg ...2,544
Pottsville .....15,710	Weatherly .....2,471
Prospect Park..1,050	Wellsboro .....2,954
Punxsutawney. 4,375	West Bethle-
Quakertown ...3,014	hem .....3,465
Rankin .....3,775	West Chester...9,524
Reading .....78,961	West Consho-
Red Lion.....1,337	hocken .....1,958
Renovo .....4,082	West Easton...1,000
Reynoldsville ..3,435	Westfield .....1,180
Ridgway .....3,515	West Hazelton..2,516
Ridley Park...1,234	West Liberty...1,281
Roaring Spring.1,344	West Newton...2,467
Rochester .....4,688	West Pittston..5,846
Roscoe .....1,354	West Washing-
Royalton .....1,106	ton .....2,693
Royersford ....2,607	West Wyoming 1,344

Pennsylvania.—Continued.

White Haven...1,517	Winton .....3,425
Wilkesbarre ..51,721	Womelsdorf ....1,136
Wilkesburg ...11,886	Wrightsville ...2,266
Williamsport ..28,757	Wyoming .....1,909
Williamstown ..2,924	York .....33,708
Wilmerding ...4,179	Yorkville .....1,125
Penza, city, Russia. p. 61,851.	
Peoria, Ills., p. 56,100.	
Perpignan, city, France, p. 35,088.	
Perigueux, city, France, p. 31,313.	
Perim, isl. str. of Bab-el-Mandeb (British). □ 5.	
Pernambuco, city, Brazil, p. 111,556.	
Persia, kingdom, S. W. Asia, □ 628,000, p. 7,653,600, * Teheran.	
Perth, town, Scotland, p. 32,872. — * Western Australia, p. 34,610.	
Peru, republic, So. Am., □ 695,733, p. 4,610.- 000, * Lima.	
Perugia, city, Italy, p. 61,292.	
Pesaro, city, Italy, p. 27,206.	
Peterborough, soke of, Northampton Co., Eng., □ 84, p. 41,119.	
Pforzheim, city, Baden, Germany, p. 33,345.	
Philadelphia, Pa., p. 1,293,697.	
Philippine Islands, group of about 2,000 isls., S. E. of China, total area est. at □ 115,- 500, p. est. 8,000,000, * Manila.	
Area of the largest islands:	
Sq. Mi.	
Luzon .....44,000	Leyte .....3,800
Mindanao .....37,500	Negros .....3,300
Samar .....4,800	Cebu .....2,400
Panay .....4,700	Nasbate .....1,400
Mindoro .....4,000	Bohol .....1,300
Principal cities:	
Pop.	
Manila .....350,000	Argao .....34,050
Lipa .....40,000	Albay .....31,000
Batangas .....39,500	Taal .....33,380
Batangas .....39,300	Carcar .....30,300
Laoang .....37,000	Calbayog .....30,250
Cebu .....35,240	
Philippopolis, * E. Rumelia, p. 41,068.	
Piacenza, city, Italy, p. 35,319.	
Pilsen, city, Austria, p. 68,292.	
Piraeus, city, Greece, p. 42,169.	
Pirmasens, city, Bavaria, Germany, p. 24,- 548.	
Pisa, city, Italy, p. 66,567.	
Pittsburg, Pa., p. 321,616.	
Plauen, city, Saxony, p. 55,191.	
Plymouth, city, Eng., p. 107,509.	
Poitiers (or Poitiers), city, France, p. 38,- 518.	
Pola, city, Austria, p. 39,273.	
Poland, prov. Russia, □ 49,159, p. 9,455,943.	
Poltava, city, Russia, p. 53,060.	
Ponce, city, Porto Rico, p. 27,952.	
Poona, city, India, p. 111,385.	
Port-au-Prince, * Haiti, p. 50,000.	
Portland, Me., p. 50,145. — Ore., p. 90,426.	
Porto Alegre, city, Brazil, 52,421.	
Porto Rico, isl. West Indies, E. of Haiti, ter. of U. S., area (including islets of Vieques, Culebra, Mona and Muertos) □ 3,606, p. 953,243, * San Juan.	
Cities of more than 5,000 pop., in 1899:	
Aguadilla .....6,425	Mayaguez .....15,187
Arceibo .....8,008	Ponce .....27,952
Caguas .....5,450	San Juan.....32,048
Guayama .....5,334	Yauco .....6,108
Port Said, city, Egypt, p. 42,095.	
Portsmouth, city, Eng., p. 189,160.	
Portugal, kingdom, S. W. Europe, □ 34,528, p. 4,660,095, * Lisbon.	
Portuguese East Africa, E. of Transvaal, □ 301,000, p. 3,120,000, * Lorenzo Marques, p. 6,630.	
Portuguese Guinea, W. Africa, □ 4,440, p. 820,000.	
Portuguese West Africa, see Angola.	
Posen, city, Prussia, p. 117,014.	
Potsdam, city, Prussia, p. 58,455.	
Pozsong, city, Hungary, p. 61,861.	

Prague, city, Austria, p. 204,478.
 Preston, city, Eng., p. 112,982.
 Pretoria, * Transvaal, p. (whites) 10,000.
 Prince Edward Island, G. of St. Lawrence,
 prov. of Canada, □ 2,000, p. 103,258, *
 Charlottetown.
 Providence, * R. I., p. 175,597.
 Prussia, Ger. kingdom, □ 134,603, p. 34,463,-
 377, * Berlin.
 Przemysl, city, Austria, p. 35,619.
 Puebla, state, Mex., □ 12,204, p. 973,876. — Its
 * p. 93,521.
 Pueblo, Colo., p. 28,157.
 Puerto Principe, city, Cuba, p. 25,102.
 Punjab, prov. Brit. India, □ 110,667, p. 22,-
 449,484.
 Punjab, states, Brit. India, □ 22,509, p.
 4,438,816.

Q

Quebec, prov. Canada, □ 347,350, p. 1,620,974,
 * Montreal. — city, Canada, p. 68,834.
 Queensland, state, Australia, □ 668,497, p.
 502,892, * Brisbane.
 Queretaro, state, Mex., □ 3,556, p. 224,848. —
 Its * p. 34,576.
 Quetta, city, Baluchistan, India.
 Quincy, Ill., p. 36,252.
 Quito, * Ecuador, p. 80,000.

R

Racine, Wis., p. 25,102.
 Radnor, co., Wales, □ 471, p. 23,263.
 Rajputana, state, India, □ 128,022, p. 9,841,-
 032.
 Rampur, city, India, p. 77,862.
 Rangoon, city, India, p. 232,326.
 Rathmines and Rathgar, city, Ireland, p.
 32,472.
 Ratisbon, city, Bavaria, Germany, p. 41,471.
 Ravenna, city, Italy, p. 68,065.
 Reading, Pa., p. 78,961. — town, Eng., p.
 72,214.
 Reggio di Calabria, city, Italy, p. 46,685.
 Reggio nell'Emilia, city, Italy, p. 60,462.
 Rennes, city, France, p. 69,937.
 Reunion, isl., 420 miles E. of Madagascar,
 belongs to France, □ 965, p. 173,192.
 Chief towns, St. Denis, St. Pierre, St.
 Paul and St. Louis.
 Reuss, Aeltère Linie, Ger. principality, □
 122, p. 68,287, * Greiz, p. 22,296.
 Reuss, Juergere Linie, Ger. principality, □
 319, p. 138,993, * Gera.
 Reval, city, Russia, p. 64,578.
 Rheims, city, France, p. 107,800.
 Rhode Island, No. Atlantic state, □ 1,250, p.
 428,556, * * Providence and Newport.
 Incorporated cities and town of 1,000 pop.
 or more in 1900:
 Central Falls, 18,167 Providence .. 175,597
 Newport 22,034 Woonsocket ... 28,204
 Pawtucket ... 39,231
 Rhodesia, large tract in So. Central Africa,
 div. by Zambesi Riv. into Northern and
 Southern Rhodesia, British, est. area □
 362,000, p. (est.) 800,000. See **Matabele-**
land and Mashonaland.
 Richmond, * Va., p. 85,050.
 Riga, city, Russia, p. 256,197.
 Rio de Janeiro, * Brazil, p. 780,000.
 Rio de Oro and Adrar, Sp. possess. W.
 Africa, □ 243,000, p. 100,000.
 Roanne, city, France, p. 33,912.
 Rochdale, town, p. 83,112.
 Rochefort, city, France, p. 34,329.
 Rochester, N. Y., p. 162,608.
 Rockford, Ill., p. 31,051.
 Rome, * Italy, p. 512,423.
 Rosario, city, Argentine Rep., p. 94,025.
 Rostock, city, Mecklenburg-Schwerin, Ger-
 many, p. 49,912.
 Rostov on Don, city, Russia, p. 119,889.
 Rotterdam, city, Holland, p. 319,866.
 Roubaix, city, France, p. 124,700.
 Rouen, city, France, p. 115,900.

Rudolstadt, * Schwarzburg-Rudolstadt, Ger-
 many, p. 11,907.
 Rumania, kingdom, E. Europe, □ 50,700, p.
 5,912,600, * Bucharest.
 Russia, empire, □ 8,644,100, p. 129,000,000, *
 St. Petersburg.
 Rustchuk, city, Bulgaria, p. 37,174.
 Rutland, co., Eng., □ 152, p. 19,708.

S

Sacramento, * Cal., p. 29,282.
 Saginaw, Mich. p. 42,345.
 Saharanpur, city, India, p. 63,850.
 Sakai, city, Japan, p. 52,203.
 Salem, city, India, p. 70,627.
 Salerno, city, Italy, p. 39,239.
 Salford, city, Eng., p. 220,956.
 Salonica, city, Turkey, p. 105,000.
 Salop, co., Eng., □ 1,343, p. 239,297.
 Saltillo, city, Mexico, p. 26,801.
 Salvador, republic, Cen. Am., □ 7,225, p.
 803,534, * San Salvador, p. 50,000.
 Salzburg, prov. Austria, □ 2,767, p. 193,247.
 St. Croix, isl. West Indies, belongs to Den-
 mark, □ 74, p. 18,000.
 St. Denis, city, France, p. 54,432.
 St. Etienne, city, France, p. 146,700.
 St. Helena, isl. So. Atlantic, Brit.sh, □ 47,
 p. 5,000.
 St. Helens, town, Eng., p. 84,410.
 St. John, city, New Brunswick, Canada, p.
 40,711. — Isl. West Indies, belongs to Den-
 mark, □ 23, p. 1,000.
 St. Joseph, Mo., p. 102,979.
 St. Louis, Mo., p. 575,238.
 Ste. Marie, No. coast of Madagascar of
 which it is a dependency, □ 64, p. 9,-
 500.
 St. Nazaire, city, France, p. 30,813.
 St. Nicholas, city, Belgium, p. 30,288.
 St. Ouen, city, France, p. 30,715.
 St. Paul, * Minn., p. 163,065.
 St. Paul de Loanda, * Angola, p. 15,000.
 St. Petersburg, * Russia, p. 1,267,023.
 St. Quentin, city, France, p. 48,868.
 St. Thomas, isl. West Indies, belongs to Den-
 mark, □ 23, p. 17,000.
 Salem, Mass., p. 35,956.
 Salt Lake City, * Utah, p. 53,531.
 Samar, isl. Philippines, □ 4,800.
 Samara, city, Russia, p. 91,672.
 Samarcand, city, Rus. Turkestan, p. 54,900.
 Samoa (or Navigator Islands), group in So.
 Pacific, belongs to Germany and U. S.,
 □ 4,076.
 Samos, isl. Mediterranean, Turkish principal-
 ity, □ 180, p. 54,830, * Vathi.
 San Antonio, Tex., p. 53,321.
 San Francisco, Cal., p. 342,782.
 San Jose, * Costa Rica, p. 25,000.
 San Juan, * Porto Rico, p. 32,048.
 San Luis Potosi, state, Mexico, □ 25,316, p.
 562,195. — Its * p. 61,009.
 San Marino, republic, Italian pen., □ 23,
 p. 2,500.
 Santa Cruz, city, Canary Isl., p. 33,421.
 San Paulo, city, Brazil, p. 64,934.
 San Salvador, * Salvador, p. 50,000.
 Santander, city, Spain, p. 50,640.
 Santiago, * Chile, p. 320,638. — city, Cuba,
 p. 43,090.
 Santo Domingo, republic, isl. of Haiti, □ 18,-
 045, p. 610,000, * Santo Domingo, p.
 14,150.
 Sarajevo, * Bosnia and Herzegovina, p. 38,-
 083.
 Saratov, city, Russia, p. 137,109.
 Sarawak, ter. on N. W. coast Borneo (Brit.),
 □ 50,000, p. 500,000, * Kuching.
 Saskatchewan, ter. Canada, □ 114,000.
 Sas'sari, city, Italy, p. 41,208.
 Savannah, Ga., p. 54,244.
 Saxe-Altenburg, Ger. duchy, □ 511, p. 194,-
 273, * Altenburg.
 Saxe-Coburg-Gotha, Ger. duchy, □ 755, p.
 229,567, * Gotha and Coburg.
 Saxe-Meiningen, Ger. duchy, □ 953, p. 250,683,
 * Meiningen, p. 12,869.

Saxe-Weimar, Ger. grand-duchy, □ 1,388, p. 362,018, * Weimar.
Saxony, Ger. kingdom, □ 5,787, p. 4,199,758, * Dresden.
Schaumburg-Lippe, Ger. principality, □ 131, p. 43,132, * Buckeburg, p. 5,620.
Schenectady, N. Y., p. 31,682.
Schwarzburg-Rudolstadt, Ger. principality, □ 363, p. 92,657, * Rudolstadt, p. 11,907.
Schwarzburg-Sondershausen, Ger. principality, □ 333, p. 80,678, * Sondershausen and Arnstadt.
Schwerin, * Mecklenburg-Schwerin, Germany, p. 36,388.
Scotland, pt. of Great Britain, □ 29,784, p. 4,471,954, * Edinburgh.
Scranton, Pa., p. 102,026.
Seattle, Wash., p. 80,671.
Sebastopol, city, Russia, p. 50,710.
Sendai, city, p. 83,325.
Senegal, Fr. colony, in W. Africa, bet. Sahara and R. Gambia, □ 115,800, p. 2,000,000.
Seoul, * Korea, p. 201,000.
Seraing, city, Belgium, p. 39,102.
Servia, kingdom, S. E. Europe, p. 19,050, 2,312,484, * Belgrade.
Sevilla, city, Spain, p. 146,293.
Shahjahnpur, city, India, p. 75,662.
Shanghai, city, China, p. 586,000.
Shansi, prov. China, □ 66,700, p. 12,211,000.
Shantung, prov. China, □ 55,500, p. 36,248,000.
Sheffield, city, Eng., p. 380,717.
Shensi, prov. China, □ 74,000, p. 8,432,000.
Shiraz, city, Persia, p. 50,000.
Sholapur, city, India, p. 74,521.
Siam, kingdom, S. E. Asia, □ 200,000, p. 5,000,000, * Bangkok.
Siberia, prov. Russia, □ 4,833,496, p. 5,727,000.
Siena, city, Italy, p. 31,367.
Sierra Leon, Brit. W. Africa, crown colony, □ 4,000, p. 74,835, * Freetown, p. 30,033.
Si-gnan-fu, city, China, on Weit R., p. (est.) 750,000.
Sikkim, India, feudatory state in Himalayas, □ 2,818, p. 30,458, * Tumlong.
Silesia, prov. Austria, □ 1,987, p. 680,529.
Sinaloa, state, Mex., □ 33,671, p. 256,858.
Sioux City, Iowa, p. 33,111.
Sivas, city, Asia Minor, p. 43,100.
Smyrna, city, Asia Minor, p. 201,000.
Sofia, * Bulgaria, p. 46,593.
Sokoto Empire (Fula), included in Nigeria.
Sokotra, isl. S. of Arabia (British), □ 1,382, p. 12,000.
Solomon Islands, E. of New Guinea, belong to Germany and Great Britain, □ 12,000.
Somali Coast, Africa, Gulf of Aden, British, □ 68,000, * Berbera, p. 30,000.
Somerset, co., Eng., □ 1,624, p. 355,060.
Somerville, Mass., p. 61,643.
Sonora, state, Mex., □ 76,900, p. 189,158.
South African Republic, Boer Republic, So. Africa, taken by British in 1900. See Transvaal Colony.
South America, see America.
Southampton, co., Eng., □ 1,466, p. 377,118, — city, Eng., p. 104,911.
South Australia, state, Australia, □ 903,690, p. 362,595, * Adelaide.
South Bend, Ind., p. 35,999.
South Carolina, So. Atlantic state, □ 30,570, p. 1,340,316, * Columbia.
Incorporated cities and towns of 1,000 pop. or more in 1900:

Abbeville	3,766	Cheraw	1,151
Aiken	3,414	Chester	4,075
Allendale	1,030	Clinton	1,869
Anderson	5,498	Columbia	21,108
Bamberg	1,533	Darlington	3,028
Barnwell	1,329	Dillon	1,015
Beaufort	4,110	Edgefield	1,775
Bennettsville	1,929	Florence	4,647
Blacksburg	1,285	Fort Mill	1,394
Blackville	1,116	Gaffney	3,937
Branchville	1,101	Georgetown	4,138
Brookland	1,089	Greenville	11,860
Camden	2,441	Greenwood	4,824
Charleston	55,807	Lancaster	1,477

South Carolina.—Continued.

Laurens	4,029	Spartanburg	11,395
McColl	1,311	Summerville	2,420
Manning	1,430	Sumter	5,673
Marion	1,831	Union	5,400
Mt. Pleasant	2,252	Walhalla	1,307
Newberry	4,607	Walterboro	1,491
Orangeburg	4,455	Winnsboro	1,765
Rock Hill	5,485	Yorkville	2,012

South Dakota, No. Central state, □ 77,650, p. 401,570, * Pierre.

Incorporated cities and towns of 1,000 or more pop. in 1900:

Aberdeen	4,087	Milbank	1,426
Beresford	1,046	Mitchell	4,055
Brookings	2,345	Pierre	2,306
Canton	1,343	Rapid City	1,342
Deadwood	3,458	Sioux Falls	10,256
Dell Rapids	1,255	Spearfish	1,163
Elk Point	1,081	Sturgis	1,100
Fla. dreau	1,244	Tyndall	1,167
Hot Springs	1,319	Vermilion	2,83
Huron	2,733	Watertown	3,352
Lead City	6,210	Webster	1,50
Madison	2,550	Yankon	4,125

South Omaha, Neb., p. 26,001.

Southern Rhodesia, (Matabeleland and Mashonaland), So. Africa, □ 192,000, p. 462,000, * Salisbury.

South Shields, town, Eng., p. 97,267.

Spain, kingdom, S. W. Europe, □ 197,671, 18,226,040, * Madrid.

Spandau, city, Prussia, p. 55,841.

Spokane, Wash., p. 36,848.

Springfield, * Ill., p. 34,109, — Mass., p. 62,059, — Ohio, p. 38,253.

Srinagar, city, India, p. 122,536.

Stafford, co., Eng., □ 1,142, p. 879,618.

Stavropol, city, Caucasus, Russia, p. 41,621.

Steppes, The, prov., Russia, □ 908,073, p. 3,451,385.

Stettin, city, Prussia, p. 210,680.

Stockholm, * Sweden, p. 302,462.

Stockport, town, Eng., p. 78,871.

Straits Settlements, Brit. crown colony, Malay Pen., □ 27,083, p. 512,342, * Singapore.

Strassburg, * Alsace-Lorraine, Germany, p. 150,268.

Stuttgart, * Wurttemberg, Germany, p. 176,318.

Styria, prov., Austria, □ 8,670, p. 1,356,058.

Suchon, city, China, p. (est.) 500,000.

Sucre, * Bolivia, p. 27,350.

Suffolk (East), co., Eng., □ 859, p. 189,152, — (West), co., Eng., □ 609, p. 117,535.

Sulu Islands, E. of Borneo (U. S.), □ 950, p. 80,000.

Sumatra, isl., Dutch East Indies, □ 161,612, p. 3,209,037.

Sunderland, city, Eng., p. 146,565.

Superior, Wis., p. 31,091.

Surat, city, India, p. 118,364.

Surinam, see Dutch Guiana.

Surrey, co., Eng., □ 707, p. 519,521.

Sussex (East), co., Eng., □ 822, p. 261,691,

— (West), co., Eng., □ 629, p. 151,541.

Swansea, city, Wales, p. 94,514.

Sweden, pt. of kingdom of Europe, □ 172,876, p. 5,097,402, * Stockholm.

Sweden and Norway, kingdom, N. Europe, □ 297,321, p. 7,328,797.

Switzerland, republic, Cen. Europe, □ 15,976, p. 3,327,207, * Bern.

Sydney, New South Wales, p. 488,968.

Syracuse, N. Y., p. 108,374, — (St. Siracusa), city, Sicily, p. 26,346.

Syria, Turkish prov., Asia, □ 109,509, p. 3,317,600.

Szabadka, city, Hungary, p. 72,588.

Szeged, city, Hungary, p. 100,552.

T

Tabasco, state, Mex., □ 10,072, p. 133,926.

Tabriz, city, Persia, p. 180,000.

Tacoma, Wash., p. 37,714.

Taganrog, city, Russia, p. 51,965.
 Talca, city, Chile, p. 42,625.
 Tamaulipas, state, Mex., ☐ 32,128, p. 203,342.
 Tangier, city, Morocco, p. 30,000.
 Tanjore, city, India, p. 57,605.
 Tantah, city, Egypt, p. 57,289.
 Tashkend, city, Rus. Turkestan, p. 156,414.
 Tasmania, isl., state, Australia, ☐ 26,215, p. 171,066, * Hobart.
 Taunton, Mass., p. 31,036.
 Tegucigalpa, * Honduras, p. 12,600.
 Teheran, * Persia, p. 250,000.
 Temesvar, city, Hungary, p. 49,977.
 Tennessee, So. Central state, ☐ 42,050, p. 2,020,616, * Nashville.
 Incorporated cities and towns of 1,000 pop. or more in 1900:

Athens	1,849	Lexington	1,332
Bolivar	1,035	McKenzie	1,266
Bristol	5,271	McMinnville	1,980
Brownsville	2,645	Martin	1,730
Chattanooga	30,154	Memphis	102,320
Clarksville	9,431	Milan	1,682
Cleveland	3,858	Morristown	2,973
Clinton	1,111	Mt. Pleasant	2,007
Columbia	6,052	Murfreesboro	3,999
Covington	2,787	Nashville	80,865
Dayton	2,004	Newbern	1,433
Dickson	1,263	Newport	1,630
Dyer	1,204	Obion	1,034
Dyersburg	3,647	Paris	2,018
Fayetteville	2,708	Pulaski	2,838
Franklin	2,180	Ripley	1,649
Gallatin	2,409	Rockwood	2,899
Greeueville	1,817	Rogersville	1,386
Harriman	2,442	Shelbyville	2,236
Humboldt	2,866	So. Pittsburg	1,789
Huntingdon	1,332	Springfield	1,732
Jackson	14,511	Sweetwater	1,716
Jellco	1,283	Trenton	2,323
Johnson City	4,645	Tullahoma	2,684
Knoxville	32,637	Union City	3,407
Lebanon	1,956	Winchester	1,338
Lewisburg	1,421		

Tepec, ter., Mex., ☐ 11,275, p. 146,805.

Terre Haute, Ind., p. 36,673.

Texas, So. Central state, ☐ 265,780, p. 3,048,710, * Austin.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Abilene	3,411	El Paso	15,906
Alvarado	1,342	Ennis	4,919
Amarillo	1,442	Farmersville	1,856
Arlington	1,073	Flatonia	1,210
Atlanta	1,201	Fort Worth	26,688
Austin	22,258	Gainesville	7,874
Baird	1,502	Galveston	37,789
Ballinger	1,128	Gatesville	1,865
Bastrop	2,145	Georgetown	2,790
Beaumont	9,427	Goldthwaite	1,282
Belton	3,700	Gonzales	4,297
Bonham	5,042	Granbury	1,410
Bowie	2,600	Greenville	6,860
Brenham	5,963	Groesbeck	1,462
Brownsville	6,305	Hallettsville	1,457
Brownwood	3,965	Hearne	2,129
Bryan	3,589	Henrietta	1,614
Burnet	1,003	Hico	1,480
Caldwell	1,535	Hillsboro	5,346
Calvert	3,322	Honey Grove	2,483
Cameron	3,341	Houston	44,633
Cisco	1,514	Hubbard	1,608
Clarksville	2,069	Huntsville	2,485
Cleburne	7,493	Italy	1,061
Coleman	1,362	Itasca	1,277
Columbus	1,824	Jacksboro	1,311
Comanche	2,070	Jacksonville	1,568
Commerce	1,800	Jefferson	2,850
Cooper	1,518	Kaufman	2,378
Corpus Christi	4,703	Kerrville	1,423
Corsicana	9,313	Ladonia	1,409
Crockett	2,612	La Grange	2,392
Cuero	3,422	Lampasas	2,107
Dallas	42,638	Lancaster	1,045
Decatur	1,562	Laredo	13,429
Denison	11,807	Lockhart	2,206
Denton	4,187	Longview	3,591
Dublin	2,370	Lufkin	1,527
Eagle Lake	1,107	Luling	1,349

Texas.—Continued.

McGregor	1,435	Sherman	10,243
McKinney	4,342	Smithville	2,577
Marlin	3,092	Stephenville	1,902
Marshall	7,555	Sulphur Spgs.	3,635
Mexia	2,393	Taylor	4,211
Mineola	1,725	Temple	7,065
Mineral Wells	2,048	Terrell	6,330
Nacogdoches	1,827	Texarkana	5,256
Navasota	3,857	Tyler	8,069
New Braunfels	2,097	Uvalde	1,889
Oak Cliff	3,630	Van Alstyne	1,940
Orange	3,835	Vernon	1,993
Palestine	8,297	Victoria	4,010
Paris	9,358	Waco	20,686
Pittsburg	1,783	Waxahachie	4,215
Plano	1,304	Weatherford	4,786
Quanah	1,651	Weimar	1,337
Rockdale	2,515	Whitesboro	1,243
Rockport	1,153	Whitewright	1,804
Rockwall	1,245	Wichita	2,480
San Antonio	53,321	Wills Point	1,347
San Marcos	2,292	Wolfe City	1,549
Schulenburg	1,149	Yoakum	3,499
Seguin	2,421		

The Hague, * Holland, p. 205,328.

Tibet, depend., Chinese Empire, ☐ 651,500, p. 6,000,000.

Tientsin, city, China, on Peiho R., p. (est.) 1,000,000.

Tiflis, city, Caucasus, Russia, p. 160,645.

Tilburg, city, Holland, p. 40,684.

Tlaxcala, state, Mex., ☐ 1,595, p. 163,244.

Tobago, isl., N. E. of Trinidad, British, ☐ 114, p. 21,400.

Tobolsk, city, Siberia, p. 20,427.

Togoland, Africa, German depend. on Slave Coast, ☐ 33,000, p. 2,500,000, * Lome.

Tokushima, city, Japan, p. 61,501.

Tokio, * Japan, p. 1,440,121.

Toledo, Ohio, p. 131,822.

Tomsk, city, Siberia, p. 52,430.

Tonga (Friendly Islands), Brit. protectorate, ☐ 874, p. 20,000, * Nukualofa.

Tongking (or Tonquin), Fr. posses., Indo-China, ☐ 119,660, p. 12,000,000, * Hanoi, p. 150,000.

Topeka, * Kans., p. 33,608.

Toronto, * prov., Ontario, Canada, p. 207,971.

Toulon, city, France, p. 101,200.

Toulouse, city, France, p. 147,700.

Tourcoing, city, France, p. 73,353.

Tournai, city, Belgium, p. 36,835.

Tours, city, France, p. 63,267.

Toyama, city, Japan, p. 59,558.

Trans-Caucasia, prov., Russia, ☐ 94,182, p. 5,516,139.

Transvaal Colony, So. Africa, British, ☐ 119,139, p. 1,094,156, * Pretoria.

Trapani, city, Italy, p. 51,747.

Trebizond, city, Asia Minor, p. 25,000.

Trenton, * N. J., p. 73,307.

Treviso, city, Italy, p. 36,906.

Trichinopoli, city, India, p. 104,690.

Trieste, city, Austria, p. 178,672.

Trinidad, isl. No. of Orinoco R., British, ☐ 1,754, p. 260,517, * Port of Spain, p. 34,037.

Tripoli, Turkish prov. N. Africa, ☐ 344,000, p. 800,000.

Trondhjem, city, Norway, p. 29,162.

Troy, N. Y., p. 60,651.

Troyes, city, France, p. 52,998.

Tsaritsyn, city, Russia, p. 55,967.

Tucuman, city, Argentine Rep., p. 34,300.

Tula, city, Russia, p. 111,048.

Tunis, Fr. protectorate, N. Africa, ☐ 51,000, p. 1,900,000, * Tunis, p. 153,000.

Turin, city, Italy, p. 359,295.

Turkestan, prov. Russia, ☐ 257,134, p. 3,898,076.

Turkey (or Ottoman Empire), Europe, Asia and Africa, ☐ 1,580,000, p. 40,000,000, * Constantinople.

Turkey, European, ☐ 65,752, p. 6,086,300.

Turkey, Asiatic, ☐ 650,394, p. 17,545,300.

Turkey, African possessions, ☐ 398,900, p. 1,300,000.

Tutuila, isl. Samoa (U. S.), ☐ 54, p. 3,800, * Pago Pago.

Tver, city, Russia, p. 53,477.

Tyrol and Vorarlberg, prov. Austria, □ 11,-324, p. 979,878.

U

Udine, city, Italy, p. 37,628.

Uganda, protectorate, E. Africa, British, 140,000, p. (est.) 3,000,000.

Ulm, city, Wurttemberg, Germany, p. 39,304.

Ulster, prov. Ireland (inc. Antrim, Armagh, Cavan, Donegal, Down, Fermanagh, Londonderry, Monaghan and Tyrone counties), □ 8,613, p. 1,581,351.

Ungava, ter. Canada, □ 456,000.

United Kingdom of Great Britain and Ireland, Europe, □ 120,979, p. 41,454,575, * London.

United States of America, area (ex. Alaska and Hawaii) □ 3,622,933, p. (inc. Alaska and Hawaii) 76,303,357, * Washington.

Upper Austria, prov. Austria, □ 4,631, p. 809,910.

Uralsk, city, The Steppes, Russia, p. 36,597.

Uruguay, republic, So. Am., □ 72,210, p. 900,600, * Montevideo.

Utah, Western state, □ 84,970, p. 276,749, * Salt Lake City.

Incorporated cities and towns of 1,000 pop. or more in 1900:

American Fork	2,732	Mt. Pleasant	2,372
Beaver	1,701	Nephi	2,208
Bountiful	1,442	Ogden	16,313
Brigham	2,859	Park City	3,759
Cedar	1,425	Parowan	1,030
Ephraim	2,086	Payson	2,636
Eureka	3,085	Pleasant Grove	2,460
Fairview	1,119	Provo City	6,185
Fillmore City	1,037	Richfield	1,969
Grantsville	1,058	Richmond	1,111
Heber	1,534	St. George	1,600
Hyrum	1,652	Salt Lake City	53,531
Kaysville	1,708	Sandy	1,030
Lehi City	2,719	Smithfield	1,494
Logan	5,451	Spanish Fork	2,735
Manti	2,408	Spring City	1,135
Mercur	2,351	Springville	3,422
Morroe	1,057	Tooele	1,200
Moroni	1,224		

Utica, N. Y., p. 56,383.

Utrecht, city, Holland, p. 102,040.

V

Valencia, city, Spain, p. 204,768. — city, Venezuela, p. 38,654.

Valladolid, city, Spain, p. 68,746.

Valparaiso, city, Chile, p. 143,022.

Vancouver, city, Brit. Columbia, p. 26,196.

Varna, city, Bulgaria, p. 28,174.

Venezuela, republic, So. Am., □ 593,943, p. 2,444,816, * Caracas.

Venice, city, Italy, p. 157,785.

Vera Cruz, state, Mex., □ 29,201, p. 853,892. — city, Mex., p. 24,085.

Vermont, No. Atlantic state, □ 9,565, p. 313,641, * Montpelier.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Barre	8,448	Northfield	1,508
Barton	1,050	Proctor	2,013
Bellows Falls	4,337	Randolph	1,540
Bennington	5,656	Richford	1,513
Brattleboro	5,297	Rutland	11,499
Burlington	18,640	St. Albans	6,239
Essex Junction	1,141	St. Johnsbury	5,666
Fair Haven	2,470	Springfield	2,040
Hardwick	1,334	Swanton	1,168
Ludlow	1,454	Vergennes	1,755
Londonville	1,274	Waterbury	1,597
Middlebury	1,897	Windsor	1,656
Montpelier	6,266	Winooski	3,783
Morrisville	1,262	Woodstock	1,284
Newport	1,874		

Verona, city, Italy, p. 71,912.

Versailles, city, France, p. 54,432.

Verviers, city, Belgium, p. 52,496.

Vevey, city, Switzerland, p. 32,982.

Vicenza, city, Italy, p. 44,244.

Victoria, state, Australia, □ 87,884, p. 1,195,874, * Melbourne.

Vienna, * Austria-Hungary, 4th city of Europe, p. 1,662,269.

Villa Rica, city, Paraguay, p. 25,000.

Vilna, city, Russia, p. 159,568.

Virginia, So. Atlantic state, □ 42,450, p. 1,854,184, * Richmond.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Abingdon	1,306	Manchester	9,715
Alexandria	14,528	Marion	2,045
Ashland	1,147	Martinsville	2,384
Basic City	1,270	Newport News	19,635
Bedford City	2,416	Norfolk	46,624
Berkley	4,988	Petersburg	21,810
Big Stone Gap	1,617	Phoebe	2,094
Bristol	4,579	Pocahontas	2,789
Buena Vista	2,388	Portsmouth	17,427
Cape Charles	1,040	Pulaski	2,813
Charlottesville	6,449	Radford	3,344
Clifton Forge	3,212	Richmond	85,050
Covington	2,950	Roanoke	21,495
Crewe	1,329	Salem	3,412
Culpeper	1,618	Saltville	1,051
Danville	16,520	Scottsville	1,248
Emporia	1,027	Shenandoah	1,220
Falls Church	1,007	Smithfield	1,225
Farmville	2,471	South Boston	1,851
Franklin	1,143	Staunton	7,289
Fredericksburg	5,068	Suffolk	3,827
Front Royal	1,005	Tazewell	1,096
Graham	1,554	Vinton	1,438
Hampton	2,764	Warrenton	1,627
Harrisonburg	3,521	West Point	1,307
Leedsburg	1,513	Williamsburg	2,044
Lexington	3,203	Winchester	5,161
Luray	1,147	Woodstock	1,069
Lynchburg	18,891	Wytheville	3,003

Vitebsk, city, Russia, p. 66,143.

Vitoria, city, Spain, p. 30,514.

Vladikavkaz, city, Caucasus, Russia, p. 43,843.

Vladivostok, city, Siberia, p. 38,896.

Voronezh, city, Russia, p. 84,146.

W

Wakayama, city, Japan, p. 63,667.

Waldeck, Ger. principality, □ 433, p. 57,913. * Arolsen, p. 2,768.

Wales, pt. of Great Britain, □ 7,441.

Walsall, town, Eng., p. 86,440.

Warrington, town, Eng., p. 64,241.

Warsaw, city, Poland, Russia, p. 638,209.

Warwick, co. Eng., □ 879, p. 347,691.

Washington, Western state, □ 69,180, p. 518,103, * Olympia.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Aberdeen	3,747	New Whatcom	9,135
Anacortes	1,476	North Yakima	3,154
Ballard	4,568	Olympia	3,863
Blaine	1,592	Port Angeles	2,321
Buckley	1,014	Port Townsend	3,443
Centralia	1,600	Pullman	1,308
Chehalis	1,775	Puyallup	1,884
Colfax	2,121	Republic	2,050
Cosmopolis	1,004	Roslyn	2,786
Davenport	1,000	Seattle	80,671
Dayton	2,216	Snohomish	2,101
Ellensburg	1,737	Spokane	36,848
Everett	7,838	Steilacoom	1,015
Fairhaven	4,228	Tacoma	37,714
Hoquiam	2,608	Vancouver	3,126
Montesano	1,194	Waitsburg	1,011
Mt. Vernon	1,120	Wallawalla	10,049

Washington, D. C., * U. S. A., p. 278,718.

Waterbury, Conn., p. 45,859.

Waterford, city, Ireland, p. 26,743.

Wei-Hai-Wei, city and port, Shantung, prov. China, leased to British (1898), □ 270, p. 118,000.

Weimar, * Saxe-Weimar, Germany, p. 26,-670.

Weisbaden, city, Prussia, p. 74,133.

Wellington, * New Zealand, p. 37,441.

West Bromwich, town, Eng., p. 65,172.

Western Australia, state, Australia, □ 975,-920, p. 182,553, * Perth.

West Ham, city, Eng., p. 267,308.

Westmoreland, co. E. g., □ 783, p. 64,411.

West Virginia, So. Atlantic state, □ 24,780, p. 958,800, * Charleston.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Ansted	1,090	Mannington	1,681
Benwood	4,511	Martinsburg	7,564
Bluefield	4,644	Monongah	1,786
Buckhannon	1,589	Montgomery	1,591
Central City	1,580	Morgantown	1,895
Ceredo	1,279	Moundsville	5,362
Charles Town	2,392	New Cumber-	
Charleston	11,093	land	2,198
Clarksburg	4,050	New Martinsv'e	1,089
Davis	2,301	Parkersburg	11,703
Elkins	2,016	Piedmont	2,115
Fairmont	5,655	Point Pleasant	1,934
Grafton	5,650	Ravenswood	1,974
Guyandot	1,450	Shepherdstown	1,154
Hinton	3,763	Sistersville	2,773
Huntington	11,923	Thomas	2,126
Keyscr	2,536	Wellsburg	2,588
Keystone	1,088	Weston	2,560
McMechen	1,465	Wheeling	38,878

Wheeling, W. Va., p. 38,878.

Wigan, town, Eng., p. 60,770.

Wilkesbarre, Pa., p. 51,721.

Williamsport, Pa., p. 28,757.

Wilmington, Del., p. 76,508.

Wilts, co., Eng., □ 1,375, p. 271,372.

Windward Islands, Brit. West Indies (comprise Grenada, St. Vincent, the Grenadines and St. Lucia), total area □ 508, p. 159,793.

Winnipeg, * prov. Manitoba, Canada, p. 42,-336.

Wisconsin, No. Central state, □ 56,040, p. 2,069,042, * Madison.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Algoma	1,738	Fond du Lac	15,110
Alma	1,201	Fort Atkinson	3,043
Antigo	5,145	Fountain City	1,031
Appleton	15,085	Glenwood	1,789
Arcadia	1,273	Grand Rapids	4,493
Ashland	13,074	Green Bay	18,684
Augusta	1,256	Hartford	1,632
Baraboo	5,751	Horicon	1,376
Barron	1,493	Hudson	3,259
Bayfield	1,689	Janesville	13,185
Beaverdam	5,128	Jefferson	2,584
Beloit	10,436	Kaukauna	5,115
Berlin	4,489	Kenosha	11,606
Black River		Kewaunee	1,773
Falls	1,938	Killbourn City	1,134
Boscobel	1,637	La Crosse	28,895
Brodhead	1,584	Lake Geneva	2,585
Burlington	2,526	Lake Mills	1,387
Cedarburg	1,626	Lancaster	2,403
Chilton	1,460	Lodi	1,068
Chippeway F'ls	8,094	Madison	19,164
Clintonville	1,653	Manitowoc	11,786
Columbus	2,349	Marinette	16,195
Cudahy	1,366	Marshfield	5,240
Cumberland	1,328	Mauston	1,718
Darlington	1,808	Mayville	1,815
Delavan	2,244	Medford	1,758
Depere	4,038	Menasha	5,589
Dodgeville	1,865	Menominee	5,655
Durand	1,458	Merrill	8,537
Eau Claire	17,517	Milwaukee	285,315
Edgerton	2,192	Mineral Point	2,991
Elkhorn	1,731	Mondovi	1,208
Ellsworth	1,052	Monroe	3,927
Elroy	1,685	Necedah	1,209
Evansville	1,864	Neenah	5,954
Fennimore	1,035	Neilsville	2,104

Wisconsin.—Continued.

New Lisbon	1,014	Sheboygan	22,962
New London	2,742	Sheboygan	
New Richmond	1,631	Falis	1,301
North Milwau-		Shullsburg	1,250
kee	1,049	South Milwau-	
Oconomowoc	2,880	kee	3,392
Oconto	5,646	Sparta	3,555
Omro	1,358	Spring Valley	1,021
Onalaska	1,368	Stanley	2,387
Oshkosh	28,284	Stevens Point	9,524
Phillips	1,820	Stoughton	3,431
Platteville	3,340	Sturgeon Bay	3,372
Plymouth	2,257	Superior	31,091
Portage	5,459	Tomah	2,840
Port Washing-		Tomahawk	2,291
ton	3,010	Two Rivers	3,784
Prairie du Chien	3,222	Viroqua	1,950
Prescott	1,002	Waterloo	1,137
Princeton	1,202	Watertown	8,437
Racine	29,102	Waukesha	7,419
Reedsburg	2,225	Waupaca	2,912
Rhineland	4,998	Waupun	3,185
Rice Lake	3,002	Wausau	12,354
Richland C't'r	2,321	Wauwatosa	2,842
Ripon	3,818	West Bend	2,119
River Falls	2,008	Whitewater	3,405
Seymour	1,026	Winneconne	1,042
Shawano	1,863		

Woonsocket, R. I., p. 28,204.

Worcester, Mass., p. 118,421. — co. Eng., □ 740, p. 358,356. — Its * p. 46,623.

Worms, city, Hesse, Germany, p. 33,175.

Wuhu, city, China, on Yangtse R., p. 85,000.

Wurttemberg, Ger. kingdom, □ 7,528, p. 2,-165,765, * Stuttgart.

Wurzberg, city, Bavaria, Germany, p. 68,747.

Wyoming, Western state, □ 97,890, p. 92,521, * Cheyenne.

Incorporated cities and towns of 1,000 pop. or more in 1900:

Cheyenne	14,087	Rawlins	2,317
Evanston	2,110	Rock Springs	4,363
Green River	1,361	Sheridan	1,559
Laramie	8,207		

Y

Yarmouth, Great, town, Eng., p. 51,250.

Yaroslavl, city, Russia, p. 70,610.

Yeisk, city, Caucasus, Russia, p. 35,446.

Yekaterinburg, city, Siberia, p. 55,488.

Yekaterinodar, city, Caucasus, Rus., p. 65,-697.

Yekaterinoslav, city, Russia, p. 121,216.

Yemen, Turkish prov. Arabia, □ 77,200, p. 750,000.

Yezd, city, Persia, p. 45,000.

Yonkers, N. Y., p. 47,931.

Yokohama, city, Japan, p. 193,762.

York, Pa., p. 33,708 — co. Eng. (E. W. and N. Ridings), □ 5,939, p. 1,891,726. — Its * p. 77,793.

Youngstown, Ohio, p. 44,885.

Yucatan, state, Mex., □ 35,203, p. 297,088.

Yukon, ter. Canada, □ 198,300.

Yunnan, prov. China, □ 155,000, p. 11,722,000.

Z

Zacatecas, state, Mex., □ 24,757, p. 447,265. — Its * p. 32,856.

Zagazig, city, Egypt, p. 35,715.

Zagrab, city, Hungary, p. 57,930.

Zanzibar Protectorate (including islands of Zanzibar and Pemba), British, □ 1,020, p. 200,000, * Zanzibar, p. 30,000.

Zaragoza, city, Spain, p. 98,188.

Zhitomir, city, Russia, p. 35,452.

Zittau, city, Saxony, p. 28,132.

Zululand, prov. of Natal, So. Africa, □ 10,470.

Zurich, city, Switzerland, p. 150,239.

Zwickau, city, Saxony, p. 50,391.

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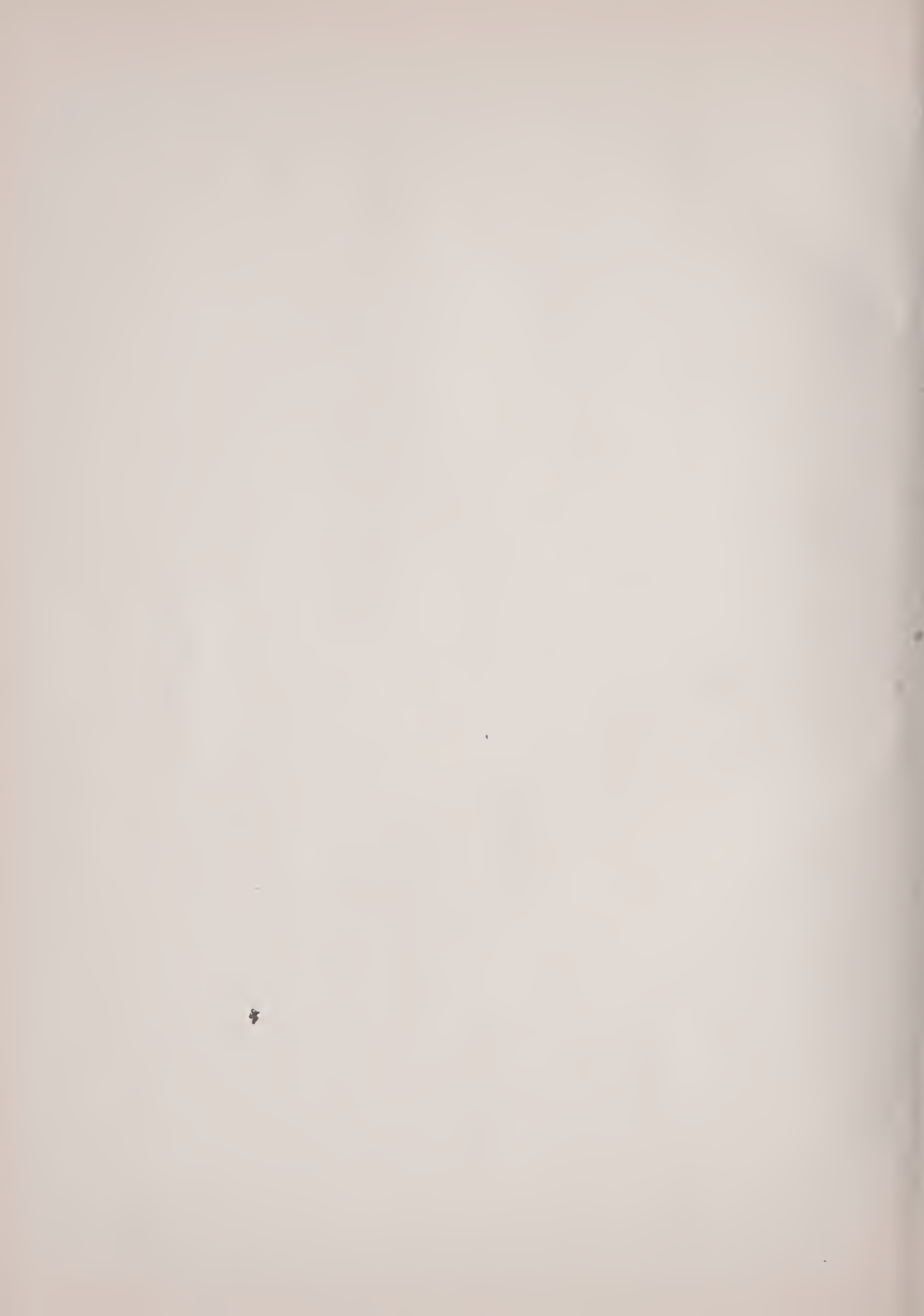
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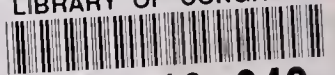
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